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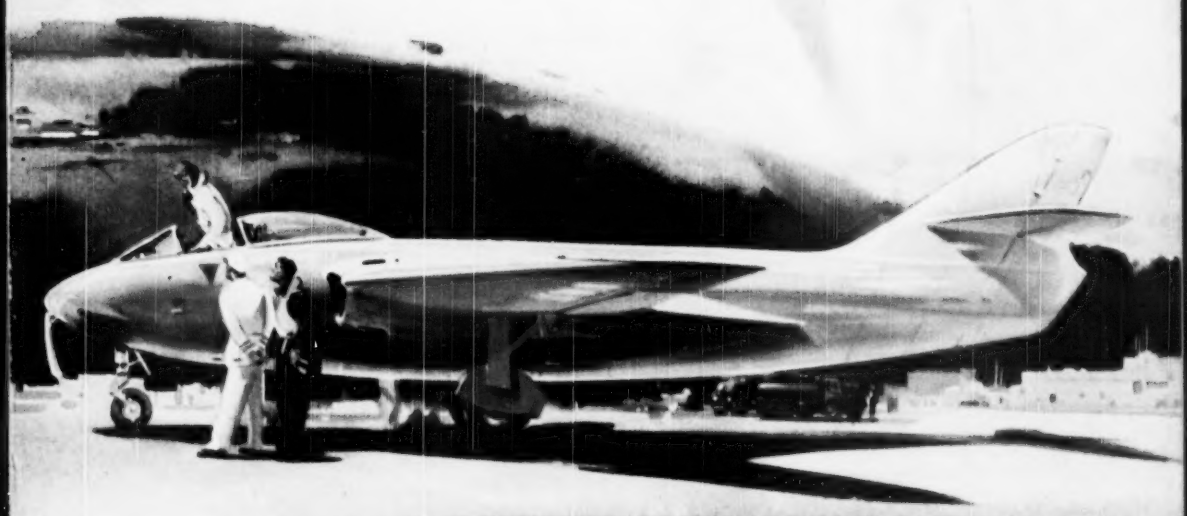

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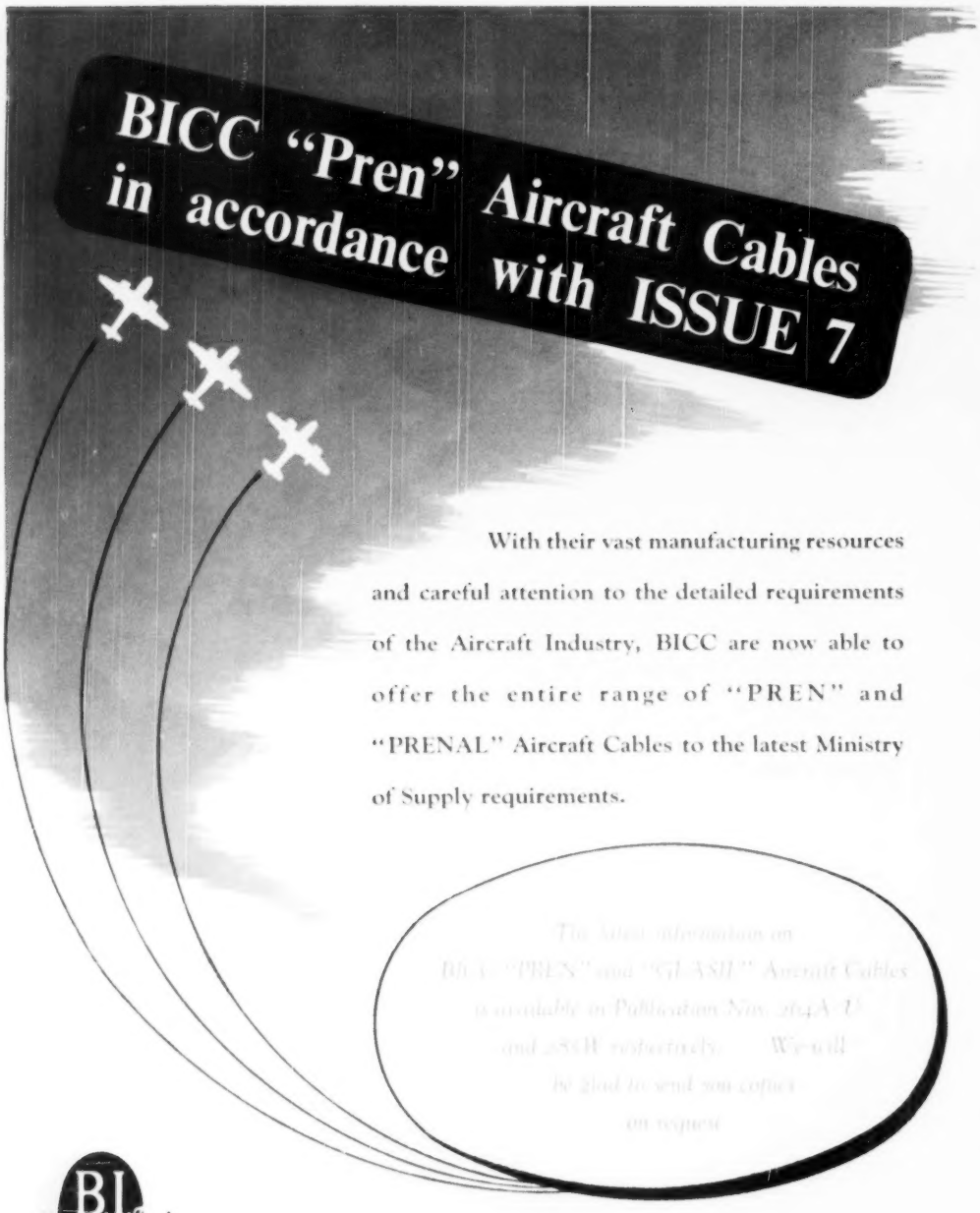

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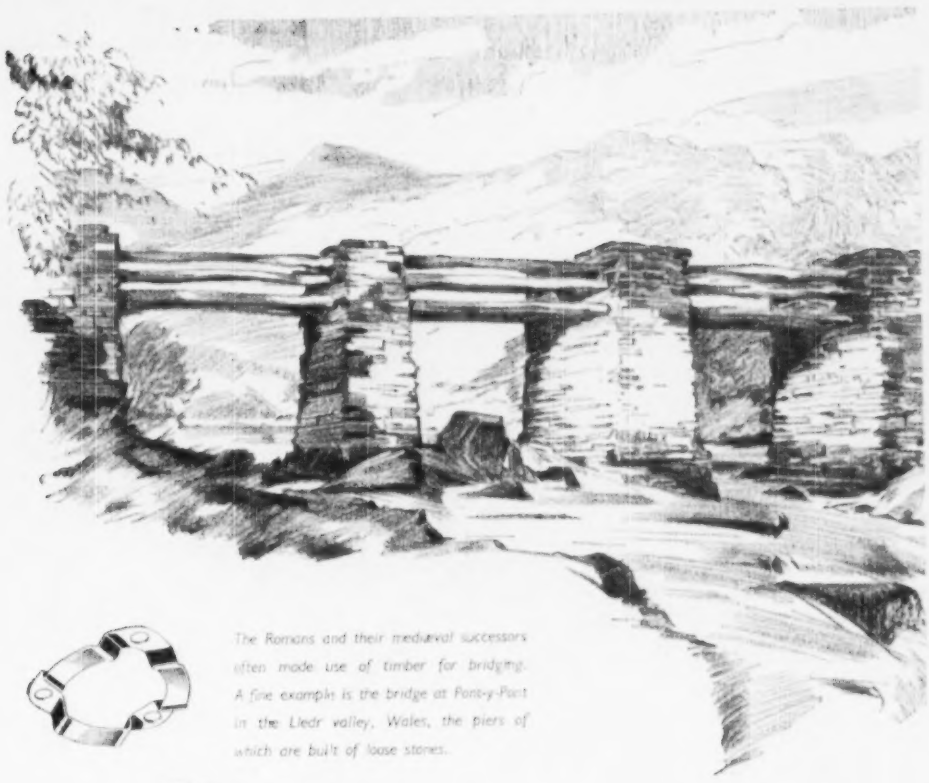

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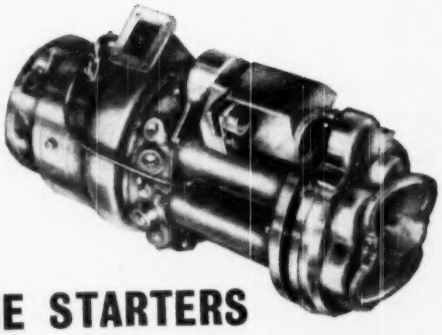

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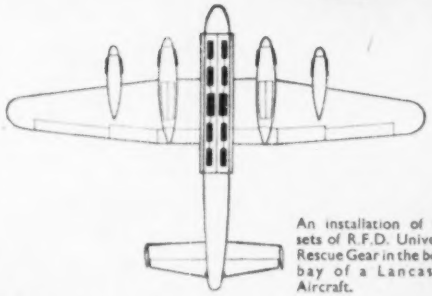

An installation of two sets of R.F.D. Universal Rescue Gear in the bomb bay of a Lancaster Aircraft.

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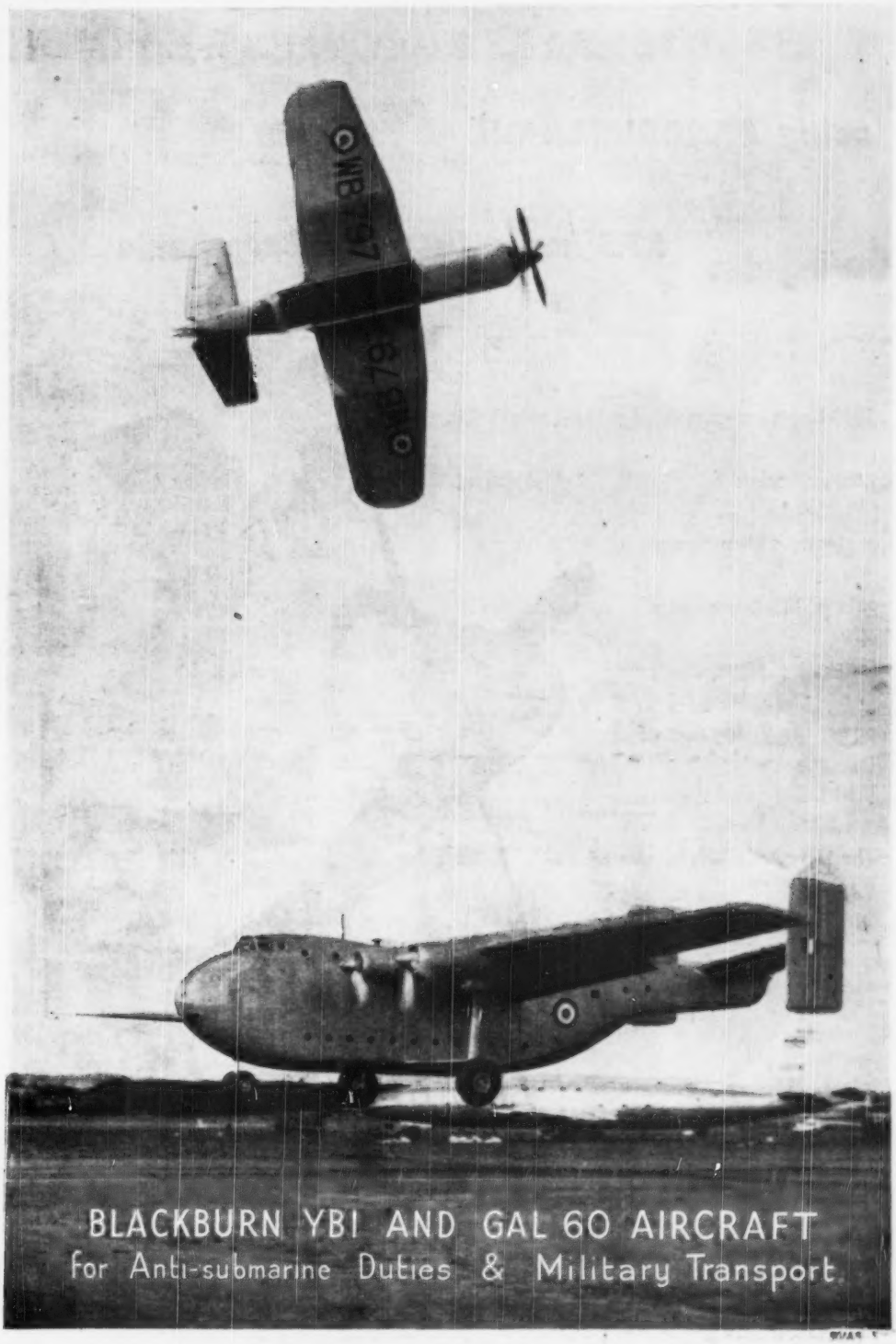
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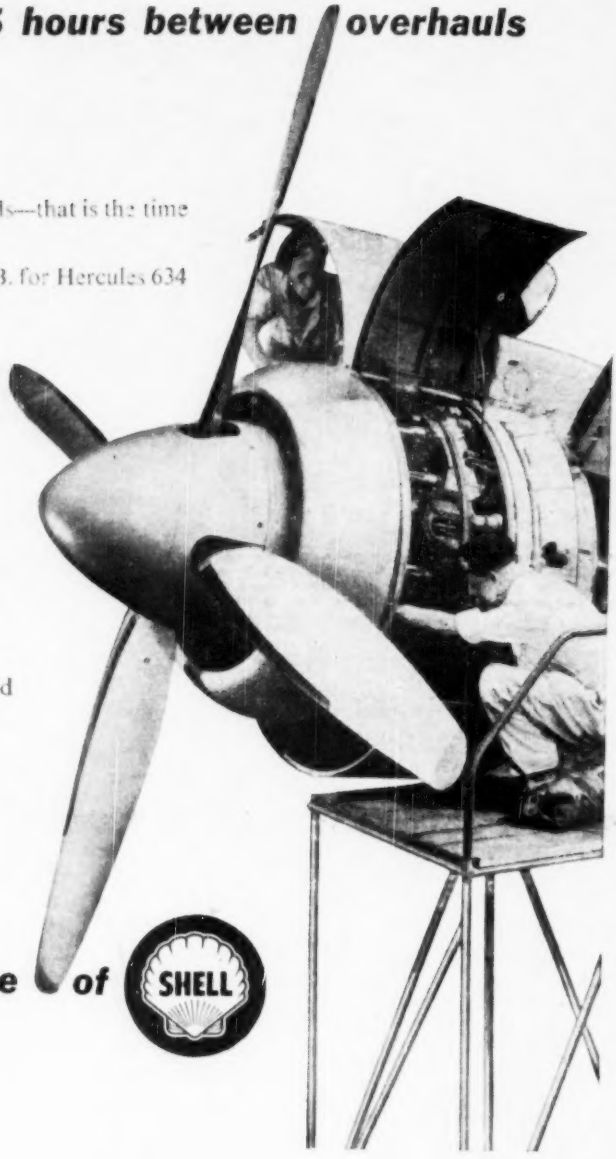

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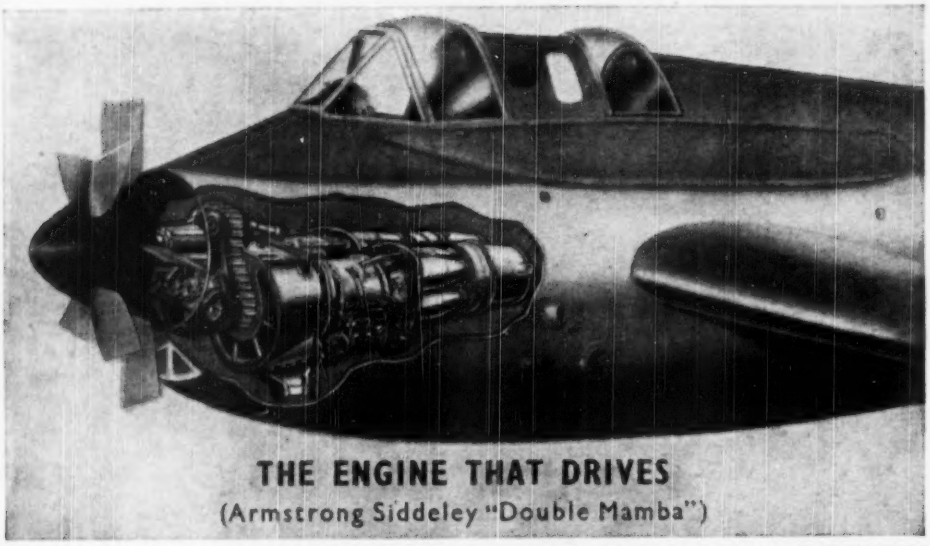

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Sobering Thoughts

LAST week two important functions took place at which members of the aircraft industry, test pilots and technicians, frankly exchanged their views on many serious topics—the contractors' dinner at Boscombe Down and the Empire Test Pilots' School passing-out dinner, referred to on pages 550 and 566. Much of what was discussed informally was confidential, but speeches revealed a marked uneasiness in many minds. This was to have been expected, even if the grave reverses in Korea had not been in the forefront of our thoughts.

As an example of what the industry is thinking, we would say that everyone is ready and anxious to tackle any assignment and every firm to begin once more an all-out effort; first, however, the overall plan must be made clear, and the industry must be shown clearly what its commitments are now to be. Security is viewed differently in each country: in some everything is secret; in America the extent of the vast orders is customarily revealed; here it still remains to be seen what will be ordered and whether such matters will be made public.

To take a second sounding of opinions expressed, there is no doubt that test pilots are perturbed about the aircraft situation. They know what is around the corner, and have the knowledge to assess its value, and here, it seems, there is real cause for encouragement. But we can only hope that Mr. Freeman's belief—expressed at Boscombe Down—that our production timing has been right will be borne out. Meanwhile, it appears that to the R.A.F.'s American B-29s will be added several hundred F-86s. There is good reason to regard this type as a most valuable low- and medium-altitude fighter. In speed it matches that of anything likely to be encountered for many months, and if there are any shortcomings in take-off, climb, or altitude performance, where these qualities are paramount we have fighters to take over.

Of the jet machines in squadron service one would like to hear more of their being flown to the limits; of regular flights to operational ceiling; of handling practice all the way up; and of realistic firing practice—not merely low-speed shooting for high scores on ground targets. After years of service no more bugs should appear, even under the added strain of operations; but has everything been done to ensure this? We ourselves believe that investigation of some problems is only now beginning. Could it be that development of new weapons on the ground is one man's concern; that to test an aircraft fitted with them another man's worry; but that operational trials at extremes of speed, height and "g" are nobody's baby?

Certainly nothing is less true than the adage "Don't worry—it may never happen." We say, "Worry and act upon your worries; that may prevent its happening."

Healthy Argument

IN this issue (pages 545-547) is reported the R.Ae.S. debate on axial *versus* centrifugal compressors; and it establishes that the article "Two-Edged Blades" in our November 16th issue hit a very important nail squarely on the head. The essential facts are that axial units can provide greater powers for lower consumptions and with lower drag-penalties—but at the expense of greater cost and complexity, and (at the moment) lesser reliability and flexibility. The limit of development in centrifugal-compressors has not been reached yet; but later forms may sacrifice some attractive simplicity and robustness.

Both Mr. Pearson and Dr. Moult made many significant observations: frontal area of centrifugals could be halved for the same through-put; turbine and combustion-system diameters were the greater embarrassment to the designer; performance stability of axials at great heights, together with their ability to cope with ice and detritus without critical trouble, was most encouraging.

Immediate problems are essentially aerodynamic for the centrifugal and blade-production for the axial. Neither is insuperable: it is simply a matter of putting the requisite brain-power into the job.

FERRY FLIGHT TO CEYLON

Wind, Water, Sand and Sun : From Prague to Colombo in Two Light Aircraft

By W. B. RILEY

ON September 11th I left Northolt Airport with Captain D. R. Turley-George in a Czechoslovakian Airline Dakota bound for Prague. We were to ferry two aircraft, an Aero 45 and a Mraz M.1D Sokol, to Ceylon, and had been instructed to reach Colombo by September 27th without fail.

Our arrival at Ruzyne Airport, Prague, evoked much less consternation than we had expected, for we had left London immediately we were notified that our visas had been granted but without the actual stamps in our passports. Our lack of visas was easily overcome by the issue of documents which would permit us to stay at the Ruzyne hotel, in the city, for twenty-four hours.

Next day we collected our visas and went later to Lecany airport, north of Prague. At Lecany Mr. Jan Andrle (who, flying an Aero 45, had won the Norton Griffiths Challenge Trophy at Birmingham in 1949) proceeded to explain the aircraft to us and gave us some check circuits. A strong wind was blowing at the time but both the Aero 45 and the Sokol performed well, the Aero 45 displaying a full-flap approach that was little short of vertical.

With several formalities yet to complete, we arranged for the aircraft to be positioned at Prague-Ruzyne for departure the following day. The British Air Attaché in Prague was unable to obtain clearance in time for us to fly over Russian-occupied Austria and it became apparent that our journey would be lengthened considerably by a detour through the Rhône Valley.

We took off from Ruzyne next morning and reached Strasbourg by lunch time. Strong headwinds were forecast, so we gave Lyons as our alternative in case we were unable to reach Cannes before nightfall. Night-flying was out of the question because of the absence of radio in either machine.

So strong were the winds we experienced that the sun had almost set when we sighted the Rhône a little north of Lyons. After landing at Lyons we picketed the aircraft in the last remaining light before seeking accommodation in the town.

Next day found us taking off as early as possible in the hope that we might reach Brindisi, or at least Rome. At Cannes our hopes were dashed by a violent wind which sprang up soon after we had landed and forced us to summon all available assistance to manhandle the aircraft into a hangar, where we parked them alongside Prince Bira's weatherbeaten Gemini.

Met. informed us that this wind, a Mistral effect, would continue for a week, and that our only hope of taking off was to leave during a temporary lull which might occur at any time. It came in the early afternoon two days later, and we were off the ground within twenty minutes. It was September 16th and we had already taken three and a half days of our time and were, in fact, further from our destination than when we started. This left us only ten and a half days in which to complete the flight.

Our first sea crossing was completed in some trepidation, for Turley-George, whose turn it now was to fly the Sokol, had only a single 105 h.p. engine. I at least had two on which to rely. Furthermore, apart from the absence of radio facilities, both aircraft were loaded to their maximum take off weight.

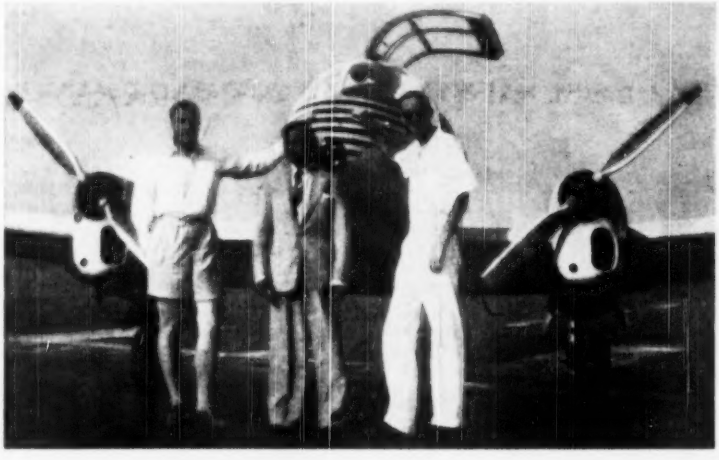
Our arrival at Ciampino Airport, Rome, on a Saturday afternoon and our subsequent departure on Sunday morning were perhaps our biggest mistakes of the flight. We found that the week-end Customs staff were not regulars and apparently had not the slightest idea what they were supposed to do. It took them three and a half hours to pass us into the country; and our departure, which should have been relatively easy, occupied over four hours and included a second examination of our baggage. The whole affair was neatly rounded off when we were presented with a bill for "fiesta tax" to an amount which would have kept us very comfortably in beer and cigarettes for the rest of the trip.

With our expectations of an early start shattered, we had to content ourselves with a short flight to Brindisi and spending the night in a dilapidated hotel, where we calculated that our deadline would permit no more delays.

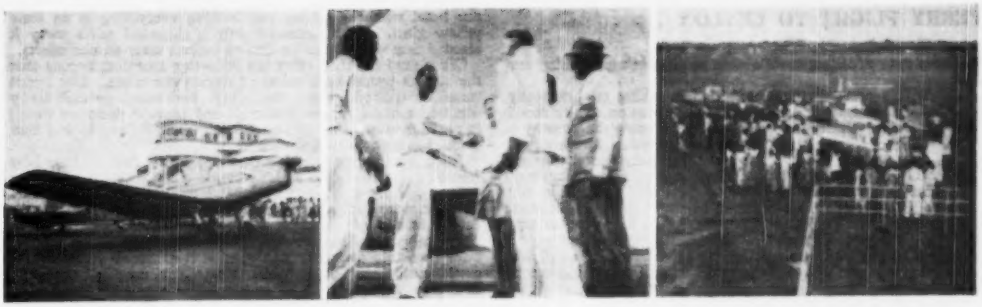
Our target next day was Rhodes, and we left Brindisi with a good weather forecast and favourable winds. The Greek and Albanian coasts were visible soon after take-off and the sea crossing was accomplished with the aid of a tail wind which seemed to alter course with us and follow us into the Gulf of Corinth.

Flying towards the Corinth Canal, now cleared of the debris of Allied bombing during the war, we experienced the ever-present bumps and had been severely shaken before we sighted Athens. From Athens our course lay direct to Rhodes and over several islands which proved useful track and ground-speed checks.

My companion, now back in the Aero 45, relieved the monotony of the flight by experimenting with its performance, discovering that it would hold height at 4,000 feet and 100 m.p.h. on one engine, while heavily laden. At about this time I was draining the long-range



Left to right: the author; D. L. Amarasekera, who purchased the two aircraft in Prague on behalf of the Government of Ceylon; and Capt. D. R. Turley-George. In the background is the Aero 45. The delivery flight was organized by the London firm of Airco Ltd., W. C. Rex Stocken's company.



Three scenes on arrival at Ratmalana Airport, Colombo: the Sokol, greetings from officials, and the aircraft surrounded by an interested crowd.

tank of the Sokol into the wing tanks when it ran dry prematurely. The air lock created gave me my first warning of its presence when the engine faltered and cut out. By the time I had cleared the fuel lines by use of an emergency gravity-feed tank behind the dashboard I was down to little more than a thousand feet and had already decided to "ditch" along the swell.

At Maritza Airfield the following day the equinoctial winds had caught up with us again and we were obliged to delay our departure until they veered around to direction of the runway in the early afternoon. There followed a turbulent crossing of the island and I was glad to be back in the Aero 45 as we passed out of sight of land. We flew the leg to Cyprus on a course calculated from a rough back-bearing on the coastline and arrived at Nicosia on track two-and-a-half hours later.

We contented ourselves with a short flight to Beirut next day in order to make an early start and cross the mountains which separate Lebanon from Syria before the clouds had time to develop to any serious extent.

Into the Heat

Our plan succeeded and we passed over the mountains, flying high, by nine o'clock the following morning. The desert appeared vast and bleak, with no sign of human habitation, until we reached H.3, a landing-ground on the oil pipeline. From H.3 we flew direct to Baghdad, and as we approached Lake Habbaniya visibility began to deteriorate in a haze of dust which extended to several thousand feet. At Baghdad Airport we experienced a taste of the heat to come, for as we circled the runway on the downwind leg the sun blazed into the cockpits, turning them into furnaces and completely blinding our view.

Our night-stop at Baghdad was made memorable by W/C. and Mrs. Beverley Barnard, who invited us to dinner, in spite of the fact that they had only just returned from Cyprus. W/C. Barnard, who is British Air Attaché in Iraq, took considerable interest in our aircraft and went out of his way to afford us some old English hospitality—and not a little Scotch as well.

Next morning we were airborne before sunrise, an effort prompted by recollections of earlier flights through the Persian Gulf in the heat of the afternoon. Our refuelling point was Kuwait, where we each consumed two quarts of iced water; the temperature was so high that the leather seats became unbearably hot, despite the canvas covers which we had slung over the cabins immediately after landing.

Taxying out, we noticed that the oil temperatures were still in the cruising range and as we lurched and bumped along the sand strip, straining to leave the ground in the calm, oppressive heat, we began to yearn for those winds we had cursed so roundly in the Mediterranean.

From Kuwait onwards our heavy loads began to tell on our take-off performance in the intense heat, and we evolved the technique of "staggering" the machines off the ground in the three-point attitude and wallowing along just above the runway until we gained speed. Under these conditions the take-off was accompanied by frightening noises from the undercarriages and, as the aircraft began to reach flying speed, the wheels would bind on the runway as though one had the tail too high. With its tailwheel on the ground the Aero 45 was difficult to keep straight in a cross wind, but the Sokol, with its steerable tailwheel, could confidently be driven down the runway at any speed, like a car.

The arrival at Bahrein was followed by speedy manipulation of cockpit, engine and pitot-head covers. The temperature was even higher than at Kuwait and we could think of little else than iced drinks and air-conditioned rooms.

From Bahrein we were faced with the unpleasant alternatives of battling against head-winds across nearly 300 miles of open sea or of spending four hours following coastlines wherever possible. Having chosen the latter course, we took off on Saturday, September 23rd, and proceeded to gain height, circling the airfield. The heat was so intense that we were obliged to seek suitable cruising conditions near 10,000 ft.

By the time we had reached 2,000 ft the oil temperature of the Sokol had reached the red line and I was able to bring it within the recommended limit only by closing the throttle and gliding down for 300 ft. For half an hour I gained height by stages and finally caught up with the Aero 45, which had been circling overhead. With our oil temperatures back to normal we set off on the long and tedious coast crawl to Sharjah, against a 30 m.p.h. head-wind.

Just in Time

Our arrival, some four and a half hours later, was greeted with the information that "overdue" action had been taken on our account, an American air/sea rescue Fortress crew at Dahran having been alerted. We were sighted just in time to prevent the search aircraft from setting off. A mild dust storm precluded refuelling until after dark, and we spent our time sitting in the air-conditioned lounge and contemplating our chances of reaching Colombo by the 27th.

Following a dawn take-off, we climbed towards a mountain range which barred our path with long, finger-like peak shadows that stretched out to beckon us on, to recede quickly as the sun mounted higher in the sky. On the long sea-crossing to the coast of Baluchistan we were heartened by the sight of several tankers steaming out of the Persian Gulf; it made the thought of engine failure seem a little less formidable.

At Jiwani we carried out instructions given to us at Sharjah and flew low over the village to indicate to the Shell agent that his services would be required.

Jiwani is a ex-R.A.F. airfield, and although the buildings are intact, with such notices as "Visiting Pilots Report Here," our arrival was greeted by the solitary figure of a Baluchistani soldier, who proceeded to turn the time-worn tee into the wind—after we had landed—and greeted us in perfect English. The control tower was locked up and everything inside was covered with a thick layer of sand. No food or water was available and we were gratified to

FERRY FLIGHT TO CEYLON . . .

find that the re-fuelling crew wasted no time in replenishing our tanks.

Up to this point we had succeeded in taking off practically together and maintaining tight or loose formation as the mood took us, but as Turley-George accelerated down the runway a cloud of sand obscured my view and took some time to drift clear. As I opened my throttles I saw the other aircraft turning on to course over the airfield, and by the time I had completed a climbing turn it was nowhere to be seen. Happy in the thought that I would soon overhaul my companion I continued climbing on course until, at 5,000 ft, I was dismayed to find visibility in the dust-laden atmosphere rapidly diminishing.

By the time I had reached the top of the haze I was flying at 9,000 ft and the sky was empty for as far as I could see in all directions.

The thought of leaving the little Sokol to fly alone along this barren stretch of coast did not appeal to me, and I began scanning the small section of coast visible beneath. I had been flying like this for nearly an hour when I sighted my companion's aircraft, a tiny speck silhouetted against the sand and almost vertically beneath me. To signal my presence I manœuvred the Aero 45 until its shadow fell directly in front of the other machine.

With formation regained we set course for Karachi and left the coast slowly receding beyond our port wing-tips. Our last view of Baluchistan was of the cathedral-like hills, sculptured through years of erosion by sandstorms. In the gathering haze and above a glass-like sea, the geological strata lent colour to a scene which might have inspired many a Salvador Dali painting.

Our arrival at Karachi airport was the signal for a host of health officials to descend upon us, demanding numerous health certificates, while we sat in our closed cabins, slowly suffocating from heat and the obnoxious fumes of an Aerosyl fumigation bomb.

Speed and Economy

When we were finally settled in our hotel we spent some time analysing our progress and performance figures obtained on the flight. Some surprising facts came to light. The Sokol was maintaining an average T.A.S. of 125 m.p.h. at maximum load, while using only five gallons of petrol per hour. The Aero 45 had done even better; with a load equal to pilot and four passengers, it had maintained the same cruising speed while using only 4 gal/hr per engine. At 4,500 ft and with maximum cruising r.p.m. the fully loaded Sokol was giving an I.A.S. of a little over 125 m.p.h. The Aero 45 under the same conditions was showing an I.A.S. of 140 m.p.h., with a consequent increase of fuel consumption to 5 gal/hr per engine. It had become apparent early in the flight that the adjustable-pitch airscrews on the Aero 45 had been set several degrees coarser than that of the Sokol.

We left Karachi the following morning with Bombay as our target and Ahmedabad as our refuelling point. We had only three days left in which to reach Ceylon, and had maintained the schedule we had decided upon at Brindisi.

At Ahmedabad we found luxurious green vegetation and grass growing everywhere, contrasting vividly with the barren desert to which we had become accustomed. We learned there that a few days previously the airfield had experienced a torrential rainfall of 23 inches in 24 hours.

Before leaving Ahmedabad we sent a cable to Belgaum, arranging for petrol and oil to be available the following day.

At Santa Cruz airport, Bombay, we learned in the met. office that we had little chance of reaching Trichinopoly for a week. The south-west monsoon was still blowing and thunderstorms were raging along our entire route. That night we arrived at our hotel with the setting sun bathing everything in an eerie yellow glow. With Colombo only a thousand miles away it seemed that we were to be denied success after all our efforts.

We visited the met. office the following morning, hoping that the storms would have subsided during the night. Our hopes were short-lived when the duty forecaster pessimistically declared that in our small aircraft and without radio we would have little chance of getting further than Belgaum, and that even to reach it would not be easy.

From our maps we noted that Belgaum could be found by following the coast and turning inland along a valley when due west of the aerodrome. This we did, and two and a half hours later we were being refuelled on the single runway, which was devoid of any of the usual buildings associated with airfields. The local population seemed to be under the impression that we were there for their entertainment, and gathered in their hundreds, sitting cross-legged and impassive along the very edges of the runway. They quickly retired to a safe distance when we restarted our engines.

We were soon climbing between huge cumulus clouds and keeping an average course which took us nearer and nearer to the gathering thunderheads further inland. Our glimpses of the terrain beneath became less frequent, and by the time we were near Bangalore the town was obscured in the dense rain of an approaching thunderstorm. Deprived of Bangalore as an alternative landing ground we began to descend through a long gap in the clouds in order to follow the Cauvery river to Trichinopoly. But at 2,000 ft we were below the overcast and were soon flying down a clear valley towards our destination.

We had only sufficient time to picket the machines in an open-ended blister hangar at Trichinopoly before the storms broke upon us. The rain came down in torrents and deafening peals of thunder were accompanied by almost continuous chain lightning which illuminated the road as we drove to the nearby European Club to spend the night. Next morning, however, a clear sky and brilliant sunshine woke us, and we left Trichinopoly in high spirits. Flying control had instructed us to orbit Ramnad airfield, for the benefit of the flying-control authorities there, before leaving the Indian mainland. We were soon flying over Adams Bridge, the chain of islands linking India and Ceylon.

As we flew South along the coast of Ceylon, we passed through several heavy rainstorms; it was in one of these that I discovered a dangerous feature of the electrical system of the Aero 45. The various electrical circuits of this machine are protected by automatic circuit-breakers which throw out the operating button when they are overloaded. I had switched on the pitot-head heater before entering the rain, and while flying on instruments noted that the directional gyro was wandering, followed soon after by the gyro horizon toppling. A check revealed that the use of the pitot-heater had thrown too great a strain on the system and operated the circuit-breaker.

Our arrival at Ratmalana Airport, Colombo, was greeted by a battery of newsreel and Press cameras and a small crowd of onlookers, including several Government officials. After a great deal of handshaking, posing and congratulations we retired to the Mount Lavinia hotel for a few much-needed luxuries.

The next few days were spent in formally handing over the aircraft and checking out the pilots of the Government Air Academy to which they had been allocated.

Much of our spare time was pleasantly occupied as guests of G/C. F. N. Worthington, commanding R.A.F. Negombo, and his charming wife, who introduced us to the sport of shooting flying foxes as they flew down to the coast to raid the fruit estates.

A fitting climax to this eventful and memorable flight was provided by the superlative comfort and incomparable speed of the B.O.A.C. Argonaut which returned us in thirty-six hours to London.

FORTHCOMING EVENTS

Dec.	14.	R.Ae.S.: "Clear-air Turbulence over Europe" by Dr. G. S. Hislop, B.Sc., A.R.T.C., A.F.R.Ae.S.
Dec.	14.	R.Ae.C.: Film Show, Londonderry House.
Dec.	22.	West Riding Aviation Centre: Annual Dinner and Dance.
Dec.	29.	R.Ae.S. (Weybridge): Annual Dance.
Jan.	6.	British Interplanetary Society: Symposium on the Orbital Rocket.
Jan.	10.	R.Ae.S. (Brough): "Problems of High-speed Flight," by H. Davies, M.Sc., F.R.Ae.S.
Jan.	10.	R.Ae.S. (Weybridge): "High-speed Flying," by S/L. J. D. Derry, D.F.C.
Jan.	16.	R.Ae.S. (Belfast): "Landing Gear and Equipment," by H. G. Conway, M.A., F.R.Ae.S.
Jan.	17.	R.Ae.S. (Preston): "Aircraft Materials," by Dr. H. Sutton, D.Sc., F.R.Ae.S.
Jan.	30.	Society of Instrument Technology: "Machining of Small Instrument Parts," by K.J.B. Wolfe and P. Spear.
Jan.	31.	R.Ae.S. (Weybridge): S. F. Cody," by G. A. Broomfield.
Feb.	3.	British Interplanetary Society: "Interplanetary Orbits," by Dr. J. G. Porter, Ph.D., F.R.A.S.
Feb.	7.	Royal United Service Institution: "Flying-boats in war," by A. V-M. P. H. Mackworth, C.B., C.B.E., D.F.C.
Feb.	12.	Institute of Transport: Brancker Memorial Lecture—"Economic Aspects of Airline Operation," by Peter G. Masefield, M.A.(Eng.), F.R.Ae.S., A.F.Inst.A.E., G.Inst.Mech.E., M.Inst.T.
Feb.	14.	R.Ae.S. (Brough): "Aero Engines," by A. Cdre. F. R. Banks, C.B., O.B.E.
Feb.	14.	R.Ae.S. (Preston): "Testing Aero-engines and Power Plants," by A. C. Lovesey, O.B.E., B.Sc., F.R.Ae.S.
Feb.	21.	R.Ae.S. (Weybridge): "Air Interception," by A. V-M. T. G. Pike, C.B., C.B.E., D.F.C.
Feb.	22.	Institute of Metals (Birmingham Section): "Metals for Gas Turbines," by J. M. Roberson, Ph.D., D.Sc.
Feb.	23.	R.Ae.S.: Fourth Louis Blériot Lecture: "Power versus Weight," by M. Maurice Roy.
Feb.	27.	R.Ae.S. (Belfast): "Aircraft Carriers," by J. L. Bartlett.
Mar.	3.	British Interplanetary Society: "Combustion in the Rocket Motor," by Prof. A. D. Baxter, M. Eng., A.M.I.Mech.E., A.F.R.Ae.S.

AXIAL *versus* CENTRIFUGAL

Royal Aeronautical Society Enjoys a Debate on a Controversial Subject

THERE are all too few opportunities in aeronautical work for controversy—all too few because controversy is a healthy exercise. A debate is, of course, a first-class medium for propounding opposing points of view, the more so because the tempo is relatively quick, and the audience gains a diffuse view of the field. That the relative merits of centrifugal and axial compressors for aircraft gas turbines is an ideal subject for controversy, was made clear by the size of the R.Ae.S. audience who listened appreciatively to the verbal battle between Dr. E. S. Moult, B.Sc., F.R.Ae.S., M.I.Mech.E. (de Havillands) and Mr. H. Pearson, B.A., A.F.R.Ae.S. (Rolls-Royce) at the Institute of Civil Engineers last Thursday, December 7th.

Dr. Moult was the first to take the floor. His opening point was that the function of a compressor was to take in the amount of air required by the engine, and to compress it at the desired ratio as efficiently as possible; for this reason, the centrifugal compressor was unbeaten in the sense that it gave the highest pressure-rise in a single stage. On this fact depended its simplicity and robustness. While he agreed that the axial led by a few points at its design condition, its pressure and volume characteristics were sharply tuned, and it was therefore more difficult to hit and hold the optima. Axial blading was sensitive to changes of incidence and, in practice, a wide range of loads and speeds had to be covered; in the interests of stability, some sacrifice of efficiency at certain points had to be accepted.

By contrast, the centrifugal compressor would maintain a high efficiency over its whole working range without the addition of any special stabilizing devices. The centrifugal was less susceptible to the effects of Reynolds number than was the axial, which might lose 5 or 10 per cent in efficiency between sea level and 40,000ft. There was a world of difference between what might be called the effective operating efficiency and a figure of thrust or consumption taken on the test-bed.

The diameter of the centrifugal compressor for a given airflow was usually larger than that of the corresponding axial unit, but this might matter or not, according to the installation. For example, it was not possible to reduce the diameter of the Vampire fuselage, which was already about the minimum to give the necessary room for pilot, guns, and so forth; in the case of the Comet, the drag of the four nacelles was less than 2 per cent of the total for the whole aircraft, and room for improvement in this direction was obviously negligible. In any event, recent developments showed that it was possible at least to halve the frontal area of existing centrifugal compressors whilst retaining the same throughput. In fact, a stage had been reached where the designer was embarrassed not by the size of the compressor but by the problem of housing a turbine and combustion system capable of dealing with the available mass-flow.

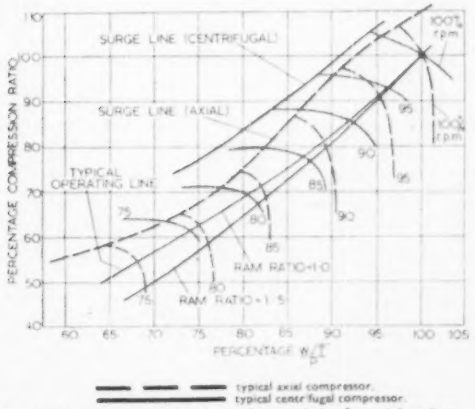


Fig. 1. Curves of pressure/volume characteristics for axial and centrifugal compressors of equal pressure-ratio. The mass-flows have been adjusted to correspond at 100 per cent. r.p.m. (Moult.)

There existed a wealth of experience with centrifugals on which the designer could draw with confidence, and it was seldom that any major change in design was necessary during development. The aerodynamics of an axial compressor were well established for the early stages, but there was a pronounced deterioration of flow in the later stages. Moreover, the best results from a gas turbine were attained only when the compressor and turbine were so matched that both components attained their peak efficiency simultaneously. The sharp characteristics of the axial made this matching process more difficult, and it was not uncommon for an axial compressor to be re-bladed many times before it attained its design performance and was free from other vices.

All compressors were subject to surging if their mass-flows were reduced below a certain critical value, and it was unfortunate that the point of maximum efficiency lay near the surge line. This made it particularly difficult for the axial, with its narrow operating band, to steer a safe course between stability and good efficiency. Anything that tended to vary the mass-flow led to trouble, and thus blow-off valves, variable-incidence guide vanes, variable-propulsion nozzles and other strange devices were used as palliatives or even as prime essentials. Dr. Moult said that he had seen an axial suddenly stall and stop because a little ice formed over the intake guard and partly obstructed the airflow, and he understood that another axial, if suddenly opened-up during an approach, emitted a ball of flame and stopped. Such serious problems might not be insuperable but they did add to the development time—always a vital question in aviation. These were a few of the reasons why, in this country, there were in service today thousands of aircraft powered by centrifugal units, compared with, at most, a few dozen with axial-flow compressors.

On the basis of similar output, the cost of an axial, whether one argued in terms of cash or of man-hours, was perhaps twice that of the corresponding centrifugal type, and this did undoubtedly lie mainly in the problems of manufacture and

Fig. 2. Comparative outlines of a typical axial and a possible centrifugal power unit of equivalent air mass-flow and thrust (Moult.)

satisfactory retention of large numbers of fixed and moving compressor blades. Serviceability meant the ability to continue the allotted function without loss of efficiency or danger of mechanical breakdown. Aircraft power-plants could not be wrapped in cotton-wool for their whole working lives, and it was here that the centrifugal scored so heavily by virtue of its simple and robust construction. A Goblin had been run at a series of combat cycles for over 1,200 hours, and at the end gave performance figures showing negligible fall-off and well within the acceptance limits for a new engine. An axial compressor, with its precise aerofoil surfaces, was much more susceptible to the effects of dirt and abrasions. Losses of 5 and even 10 per cent had been experienced in the course of a type-test of 150 hours' duration.

No one could deny that the vibration problems in the blading of an axial compressor were much more complex than those of a centrifugal impeller. Each blade had many forms of vibration, and there were many types of blade even in a single compressor. To dodge all resonant frequencies on all blades throughout the whole speed range was well-nigh impossible; and, in fact, the problem of holding these frequencies and of exploring all possibilities during development testing was itself formidable.

Experience had shown the centrifugal to be particularly resistant to snow and ice. Because of the speed and working temperature of the impeller, ice would not stick in quantities likely to affect performance. A lump of ice weighing 6 or 7 lb

AXIAL *versus* CENTRIFUGAL . . .

was inhaled some time ago by a Ghost engine; but apart from producing a momentary hiccough it caused no permanent damage, and the particular impeller continued in regular use. A Vampire flying in a storm over Switzerland encountered hailstones of over 2in diameter; they seriously battered the airframe and intake ducts, but the impeller was undamaged and the engine continued to function normally. In Canada, a squadron of Vampires flew through a dense flock of birds. The official report stated that the engines operated normally after a short period of rough running, and concluded with the words "it appears, therefore, that the Goblin 2 can swallow birds without damage or effect on performance." Dr. Moult ended his discourse with the comment "I hesitate to think what could have happened to present-day axial compressors in similar circumstances."

Mr. Pearson then came to the rostrum to present the pro-axial view. He had been a great believer in the past in the centrifugal compressor, and had no doubt that, at the present time, there were many uses for both types of gas turbine; but in reviewing the possibilities of the greatest possible performance, and especially in looking to the future development of compressors, he was convinced that the axial compressor easily had the ultimate advantage.

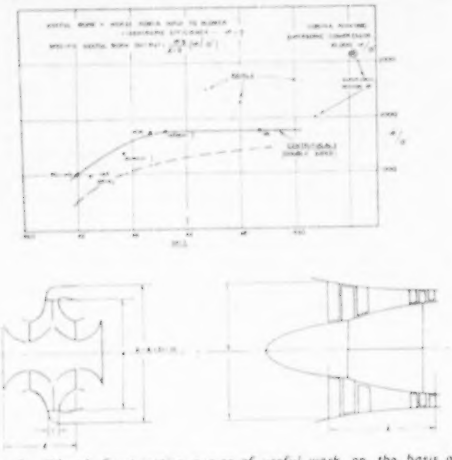


Fig. 3. (Above) *Comparative curves of useful work on the basis of useful power divided by cross-sectional area of the compressor.* (Pearson.)

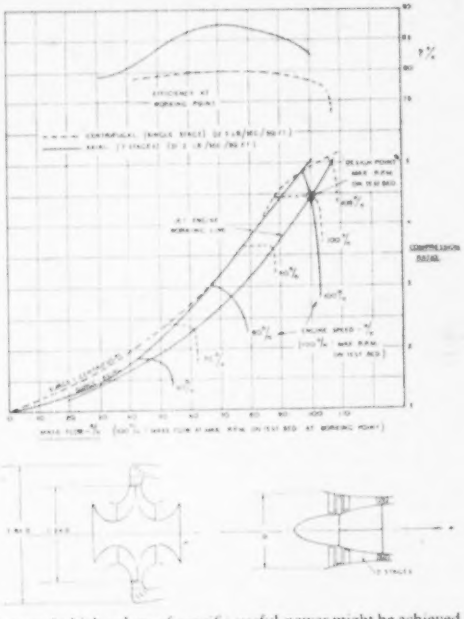
Fig. 4. (right) *Characteristics of two actual compressors at the same compression ratio and scaled to the same mass-flow. The relative signs are also shown, together with the working-lines.* (Pearson.)

It was generally a by-word that axial compressors were the more efficient; but, to emphasize the point, a summary of Rolls-Royce data for both types at various compression ratios showed the general conclusion that, at almost any compression ratio up to at least 7:1, the axial compressor gave 7 per cent better efficiency. The reason appeared to lie inherently in the method of doing the work; in the axial, the air was given a small amount of velocity, and this was then diffused to pressure, the process being repeated many times. In the centrifugal, the work was all done at one go. This would be all right if the losses remained proportional to the velocity squared but, unfortunately, the velocities at the impeller tips were so high that the consequent diffuser losses were out of all proportion.

The advantages of low frontal area might be arguable where engines were installed in the fuselage of already large aircraft but, with the great increase in speed and the possibility of supersonic flight, and particularly in wing installations, the accent was quite definitely on low frontal area. In a comparison between actual axial and centrifugal compressors, it could be shown that the former could pass some three or more times as much air as the latter.

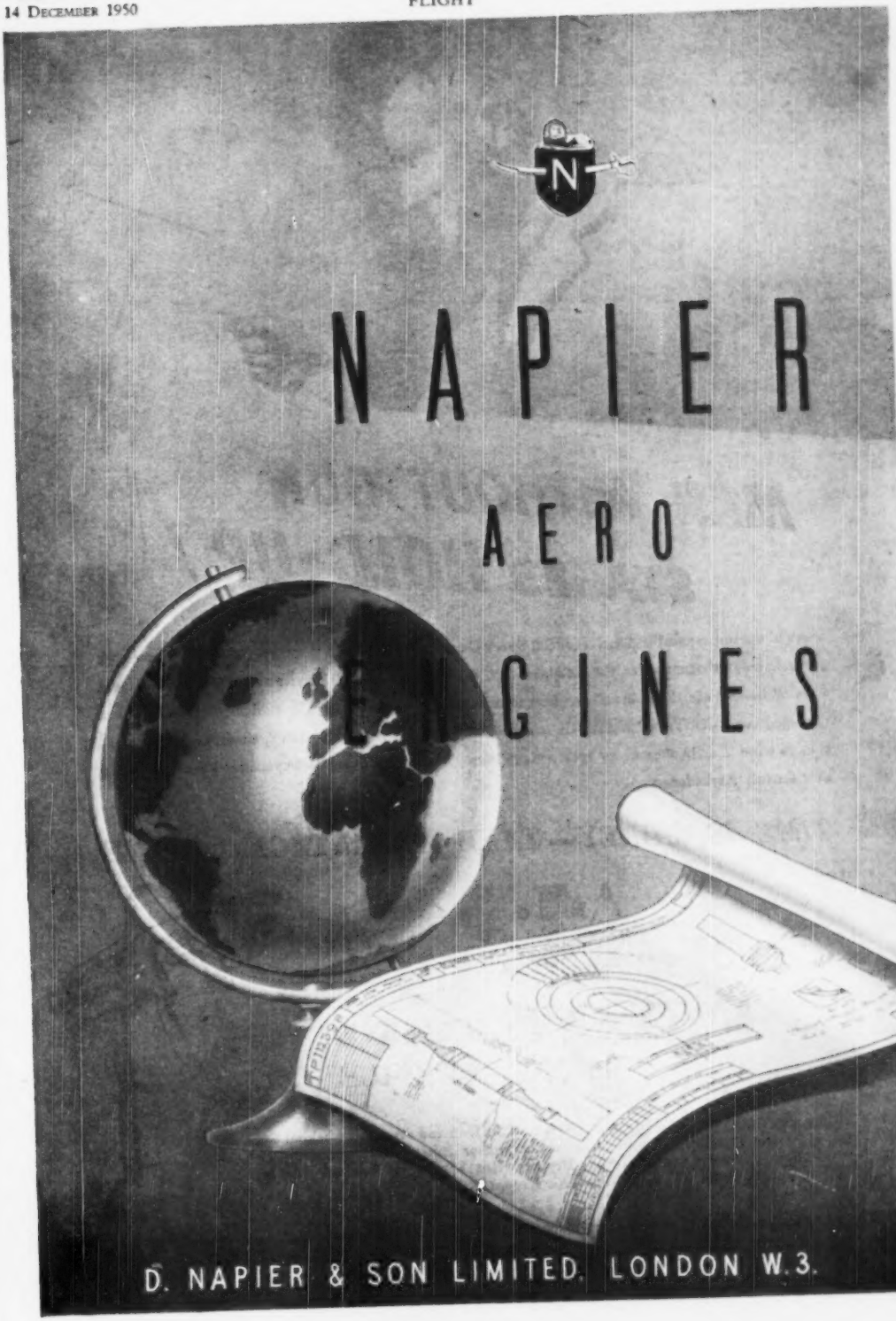
The axial might be slimmer, but it was usually longer up to the compression-ratio limit of a single-stage centrifugal, and it had been claimed that this led to greater compactness and reduced weight for the centrifugal. Weight, however, was difficult to argue about logically—owing to the number of variables—and bulk was more a subject of calculation, being largely aerodynamically limited and, in the opinion of the speaker, the ultimate controlling factor in weight. If one considered the volume occupied by a compressor for a given power, this would be a useful method of comparison; but, unfortunately, the ratio was directly susceptible to the square-cube law when scaling and thus would not be satisfactory for comparing compressors over a large range of sizes. However, by plotting the useful power divided by the cross-sectional area, i.e., the area of the compressor seen on a drawing, an ingenious method of comparing compressors independently of size was obtained.

On this basis, the two types of compressor were on a much more even footing, but later development in axials gave them a superiority by a factor of 50 per cent. Attention was beginning to turn to the possibilities of the supersonic axial compressor, and it was probable that this would entail some large sacrifice in efficiency (say, to make them comparable to the centrifugal in this respect), but without sacrifice on frontal area extremely high values of specific useful power might be achieved.



By flexibility was meant the ability of the compressor to operate satisfactorily away from its design point. Certainly, if an extremely high range of mass-flow at a given speed was required, then the centrifugal was generally the best, but this in itself was not a useful requirement for gas turbines. It was the position of the characteristics at various speeds that mattered, and the range of efficient operation of the outlet conditions. It was demonstrable that the axial compressor at the same compression ratio was not inferior to the centrifugal, and an interesting comparison could be made of two actual compressors at the same compression ratio and scaled to the same flow. The axial might be a little stickier on acceleration at low speeds, while the centrifugal would be the worse, and might even surge, under altitude conditions. Either of these possibilities might be avoided by working farther down the characteristic, or by other ingenious devices. However, whilst each type of compressor was eminently suitable, the axial was much the more efficient, had rather less than half the frontal area and considerably less bulk.

Mr. Pearson believed that the axial was capable of much greater development than was the centrifugal. The axial could be split up stage by stage, its separate performance analysed and tested; furthermore, the detail flow at all stages could be examined by well-known methods. No such analysis or breaking-down of a centrifugal blower was really possible, as each part essentially demanded the presence of the others for even an approximately correct functioning. The axial compressor he also believed to be in the direct line of general aerodynamic development. For example, the improvements in high-speed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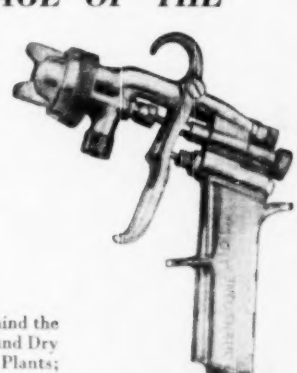

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wings from the study of boundary layers had their equivalent in blade theory. No such condition existed in the centrifugal blower, whose progress had to rest on a large number of *ad hoc* tests guided, of course, by good general aerodynamic knowledge, but no more.

MR. J. L. P. BRODIE (de Havillands) acted as second string to Dr. Moult, and started off by saying that he intended to bring the subject-matter back to earth. With the huge engine projects which obtained nowadays, it was impossible to work without government assistance, and that assistance was forthcoming because the military demands were predominant. It therefore followed that engine manufacture in time of war was a paramount consideration, and on this basis, the very complexity of the axial unit made a serious production problem. Mr. Brodie then quoted the article "Two-Edged Blades" (*Flight*, November 16th, 1950), and went on to state that not much was known in this country about the quantity production of axial units; he was, however, assured that the axial was approximately twice as expensive as the centrifugal to produce, either in terms of man-hours or cost. Die-life was short, and in addition to the difficulty of obtaining sufficient skilled toolroom labour to manufacture the dies, there was the difficulty of finding twice the factory area and four times the number of machine tools required to produce a given number of axials for the same number of centrifugals. He was sure that vulnerability was the greatest weakness of the axial type, and this was also borne out by the loss in performance sustained by the axial between overhaul periods as a result of loss of blade profile by fouling, erosion and so forth.

MR. A. C. LOVESEY (Rolls-Royce) then rallied to the axial cause. He said that the greater efficiency of the axial had shown up under *all* conditions, including flight-tests, and measured figures showed an average improvement of 17 per cent in specific consumption on a 150-hour type-test; this represented a saving of 13,000 gallons of fuel. On the score of weight and compactness, a comparison of an axial and a centrifugal designed by the same team, and each having a similarly good specific weight (0.282 lb weight/lb thrust) at the same flame temperature, showed the axial to have a 70 per cent greater thrust per square inch of frontal area.

In terms of flexibility, some axials were certainly more temperamental than some centrifugals, but against this, axials were now flying which were better in this respect than any centrifugal. The reliability of axials to-day was just as high as, if not higher than, that of centrifugals; furthermore, there was evidence that the axial was kinder to the combustion unit. Cubes of ice with 1½in sides had been shovelled into an axial with no ill-effects. Moreover, air tests simulating icing conditions by means of a spray rig had allowed the formation of large lumps of ice which were inhaled into the engine but again without ill-effect. In any event, measures existed to de-ice the intake, though it should be emphasized that the axial was *not* critical to ice. Pieces of steel had been consumed by an axial, but the effect was only to notch the blades; and all that was then necessary was for the notches to be filed out, and the blades were thereafter quite usable.

It was true to say that the axial was more expensive to build than the centrifugal, but the cost would undoubtedly fall rapidly with increase in production. Cost was mainly absorbed by the blades, but great advances had been made in blade production, particularly in pressed instead of forged techniques. Mr. Lovesey closed his contribution with an illustration of six fuel-tanker lorries which, he said, represented the amount of fuel saved by an axial in 500 hours. This could be interpreted in many ways, viz., payload, cost, range and so forth.

The Debate Thrown Open

This concluded the main portion of the debate, and the President of the Royal Aeronautical Society, Major G. P. Bulman, then opened the meeting for discussion. Salient comments made from the floor of the auditorium are summarized below.

MAJOR F. B. HALFORD (de Havilland): Cost *did* matter, as witness the American efforts to reduce it. Furthermore, despite the great attention paid in the U.S. to axial development, the lowest specific consumption for an American axial engine was 1.05 lb.

MR. F. M. OWNER (Bristol): Five-figure power outputs were now upon us, and this emphasized the very real importance of frontal area. Both protagonists had seemed to fight shy of compression ratios, but these must inevitably go higher, and a concomitant was greater component efficiency.

MR. W. H. LINDSAY (Armstrong Siddeley): If we wished in the future to carry heavier loads farther and faster than we did to-day, there was no other way to do it than with axials.

MR. L. J. CHESHIRE (English Electric): The chief defect of the centrifugal was its low efficiency, and it would be in the country's interest to pay some attention to the aerodynamics of centrifugal compressors, for only that way could efficiency be improved, and then the centrifugal could match the axial even on specific consumption.

MR. HAYNE CONSTANT (National Gas Turbine Establishment): People were too greedy in their claims for the axial; it had a great many advantages, but all of these could not be obtained simultaneously. One could have two outstanding advantages and parity on the other points—surely this was enough.

MR. E. L. CARLISLE (Air Registration Board): Airlines did not like to bear the cost of elaboration in power-plants, and would rather have a simple engine which could cope with the hurly-burly of regular airline service. He thought that the centrifugal would reach 1,000-hour overhaul periods long before the axial.

DR. H. ROXBEE COX: Surely there was a place for both. For certain purposes, the axial was obviously best, but the robustness, reliability and ease of manufacture of the centrifugal was telling for civil use and would be for a long time to come.

MR. G. R. EDWARDS (Vickers-Armstrongs): Reliability of the axial seemed to be a function of size. We could wage a war next week with centrifugals, and a war in a few years with axials, and that was a very comfortable state to be in.

MR. V. N. BUTLER (Omes, Ltd.): The forging people had not really been put to the test on axial blades, and it was likely that they were just as much concerned as anybody else with the production of cheap blades.

MR. WILDE (Rolls-Royce): The greatest losses in the centrifugal were in the diffuser, and if a stator was put behind the rotor of a centrifugal unit, then its efficiency would match that of the axial.

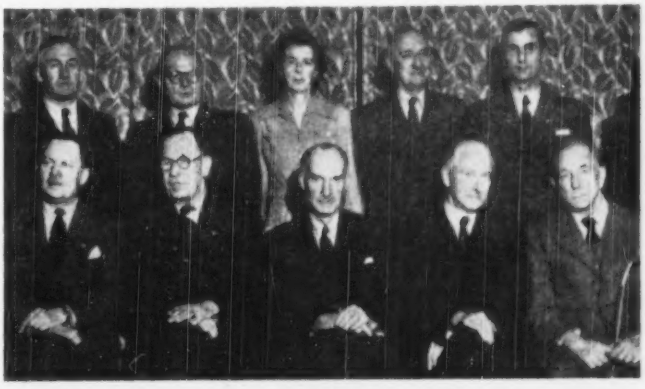
TWENTY YEARS AND MORE : D.H. VETERANS FORGATHER

WHEN the de Havilland "Twenty Years' Service" Club held its recent annual gathering there were 21 new members, which means that 242 people have served the Enterprise for 20 years or more; of these, 209 are still working, 24 are retired, and nine have died.

Formed in 1940, the Club started with 17 people who had then served 20 years, and they included the five directors who are at the helm today. These five, and six of their 1920 associates, are still going strong; three others have retired and three have died.

At the gathering was Mr. Alan Butler, who retired from the chairmanship in June. The new chairman, Mr. Frank Hearle, made a brief speech expressing his pleasure at being among so many old friends, as did Mr. W. E. Nixon. The later recalled that, though the year 1930 was one of depression, it saw the consolidation of the D.H. companies throughout the world—thanks to the initiative of Mr. St. Barbe.

Sir Geoffrey de Havilland distributed £20 cheques, and certificates depicting the arrival of Miss Amy Johnson's Moth in Australia on May 5th, 1930.



Ten of the eleven "founder-members" have served for 30 years. Left to right (seated): F. E. N. St. Barbe, W. E. Nixon, Sir Geoffrey de Havilland, F. T. Hearle, C. C. Walker. (Standing) A. J. Brant, G. K. Carlson, Miss J. Dunman, A. H. Morse, R. Hutchinson. S. T. Webb was unable to be present, but two retired members, H. Fidler and F. Cole, were there.

HERE and THERE

Attackers for Pakistan

PAKISTAN'S order for a number of Vickers-Supermarine Attackers is understood to have been affected by the need for priority in re-equipping British Naval squadrons. Only a few Attackers will be delivered to Pakistan before the end of 1951 although, it is reported, the delivery of piston-engined Hawker Furies will be speeded up.

Sabres: The Prospect—

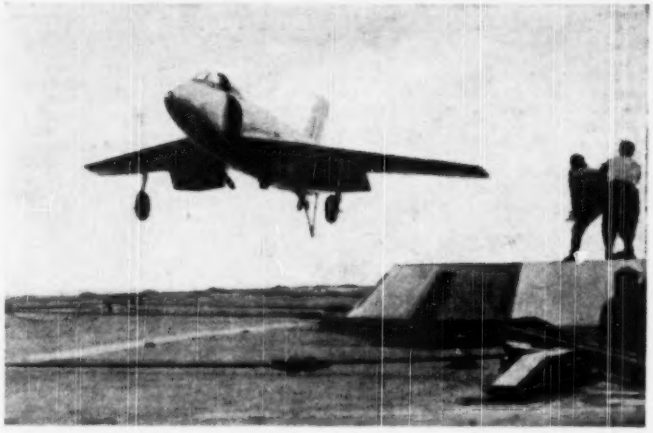
NO official comment is forthcoming on reports that large numbers of American aircraft will be supplied to the R.A.F. and other Western Union air forces. According to *Aviation Week*: "Nearly 500 F-86 Sabres will go to the R.A.F. and eventually the plane will be manufactured in France. About 300 F-84 Thunderjets will be shipped to European nations next year, with approximately 800 of this type expected to be in French and Italian hands by the end of 1952. . . . F-84s now in use by the U.S.A.F. . . . are scheduled for transfer to England and France late next spring." In the transport field, says the journal, the Fairchild Packet and Canadair North Star may be licensed for production, respectively, by Britain and Canada, and Britain and Italy.

—And the Present

IN view of the report mentioned in the preceding item, there is particular interest in the news that the R.A.F. Central Fighter Establishment has been testing the operational characteristics of two North American F-86 Sabres. A U.S.A.F. fighter group of these aircraft may visit this country shortly on rotational training, replacing the 60 F-84 Thunderjets which, until recently, were based at Manston.

Docile Delta

WITHIN the speed-range so far investigated, the Avro 707B delta-wing research aircraft (illustrated overleaf) has displayed "no adverse characteristics." Several complete rolls have been made; the ailerons have proved to be powerful, giving a high rate of roll. Two landing procedures have been investigated: the use of an anti-spin parachute to introduce drag just before touch-down, and a conventional approach at a high angle of incidence.

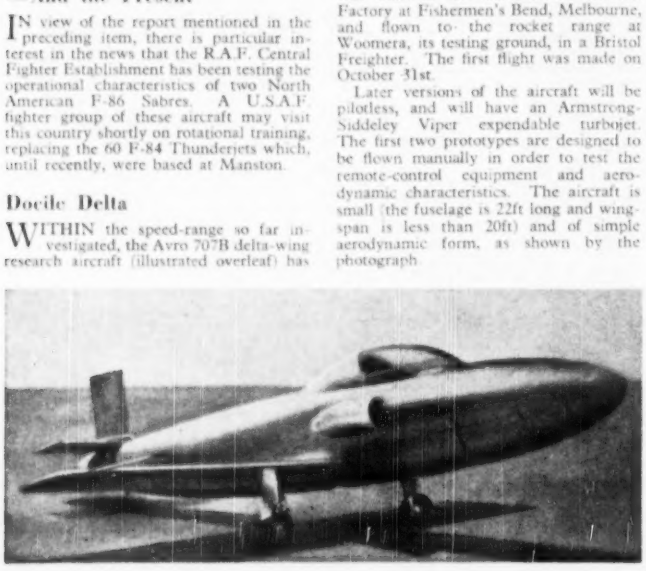


ON THE DECK: Piloted by Lt. Elliott of the R.A.E., Farnborough, the Vickers Supermarine 510 is seen landing-on during recent trials with H.M.S. "Illustrious." Other pilots in the same trials were Lt. Parker, D.S.O., D.S.C., and Lt. Cdr. Michael Lithgow, Supermarine's chief test-pilot. Take-offs were made with R.A.T.O.G.

Australia's First Jet

AN Armstrong-Siddeley Adder turbojet of 1,100 lb thrust powers the first Australian-designed jet aircraft, illustrated below. This prototype, so far nameless, was built at the Government Aircraft Factory at Fishermen's Bend, Melbourne, and flown to the rocket range at Woomera, its testing ground, in a Bristol Freighter. The first flight was made on October 31st.

Later versions of the aircraft will be pilotless, and will have an Armstrong-Siddeley Viper expendable turbojet. The first two prototypes are designed to be flown manually in order to test the remote-control equipment and aerodynamic characteristics. The aircraft is small (the fuselage is 22ft long and wingspan is less than 20ft) and of simple aerodynamic form, as shown by the photograph.



AUSTRALIA'S FIRST jet aircraft is this small Adder-powered prototype, which is now undergoing flight trials. Later versions will be pilotless. Further details of the project are given above.

Improved Ski-designs

CONSIDERABLE success is claimed by Canada's National Research Council to have rewarded recent investigations into the design of skis for aircraft. The main problems involved were "sliding resistance," which can delay or even prevent take-off, and freezing of skis to the snow while the machine is stationary.

Centurion Strafed

FOUR American rocket-firing jet fighters were despatched on December 11th to destroy the British Centurion tank abandoned after losing a track in the retreat from Pyongyang. The results of their attack, which was directed by officers of the 8th Hussars in an A.O.P. aircraft, have not been announced.

Meteor 8s for Korea

AUSTRALIA has ordered Gloster Meteor 8s for re-equipment of its Mustang squadron—No. 77—now fighting in Korea. Mr. Menzies, the Australian Prime Minister, announced last week-end that 36 Meteors had been ordered, and were likely to be delivered early in the New Year. He also mentioned his Government's intention of buying a "small number of jet reconnaissance-bombers" in the United States—presumably because Australia's intended production of the Canberra is not sufficiently advanced to meet her immediate requirements.

As a ground-attack aircraft (probably its major function in Korea), the Meteor 8 carries a formidable war-load: two 1,000-lb bombs or eight 90-lb rockets are typical combinations. Although equipped for close-support work, R.A.F. Meteors are employed almost exclusively on interception.

Spotters' Contest

ENTRIES are invited for the fourth annual contest for the Silver Hurricane Trophy of the Aircraft Recognition Society. The competition, which will take place in the lecture theatre of the Science Museum, South Kensington, on January 20th, will consist of 35 flying views of present-day aircraft projected on to a screen. It is open to teams of three

members representing any recognized club, society or body interested in recognition, or the Services or Royal Observer Corps. The winning team will be presented with the Trophy by Mr. Peter Masefield, president of the Society. Further details are available from the chairman, E. G. A. Wilton, "Lamorna," Taymount Rise, London, S.E.23.

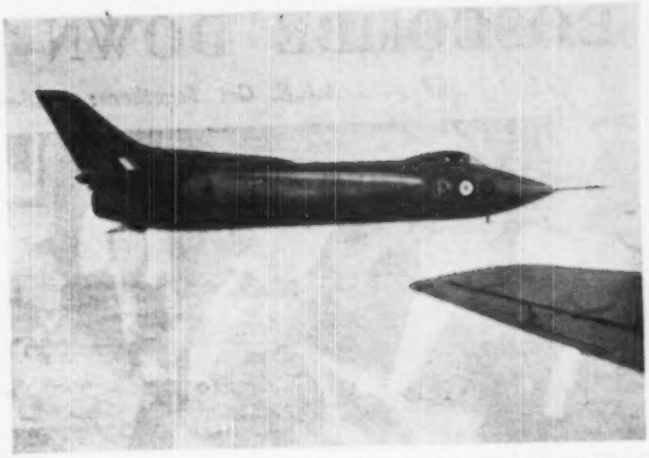
New Records

A GLIDER flight and several model-aircraft performances have been homologated by the F.A.I. S. R. Laroy-Mansson (Sweden) established a new soaring record for distance with fixed goal and return to starting-point when, on July 7th, he flew 242 miles in a Weihe Se104. The world duration record for model aircraft was captured by L. Sikirine (U.S.S.R.) on August 18th; his 9.8 c.c.-engined model flew for 4 hr 2 min 30 sec. Of ten other new model records, Hungary holds six, Russia four and France one.

STRAFER : Lt. Andrew Johnson, seen climbing from his F-80C, is one of several Negro pilots flying Shooting Stars on ground-attack work in Korea for the United Nations forces.

R.Ae.C. Films

THE next film show at Londonderry House for members and associate members of the Royal Aero Club, to be held on December 14th, will consist of three pictures: *Air Progress* (concerning developments in America); *A de Havilland Diary*, and *Pegasus* (depicting the work of the airborne forces). The programme begins at 6.15 p.m. and runs for an hour and a quarter.



"EASY AND PLEASANT" : Since its first flight at Boscombe Down about three months ago the Avro 707B delta-wing research aircraft, a new flying picture of which is presented here, has made more than 100 flights. On all occasions the pilot was W/C. R. J. Falk who reports the 707B "an easy and pleasant aircraft to fly." The total flying time accumulated to date is about 25 hours.

NEWS IN BRIEF

DURING her recent visit to England, Her Majesty Queen Juliana appointed as an Officer of the Order of Oranje Nassau W/C. J. C. G. Bell, sales manager of the Sperry Gyroscope Co., Ltd.

* * *

Mr. C. Colin Cooper announces that the registered address and London offices of C. B. Helicopter Hire, Ltd., have been moved from 45, Bloomsbury Square and 30, Chelsea Square, and combined in Suite 115/120, Abbey House, Westminster, London, S.W.1.

* * *

Leaflets issued by the Airscrew Co. and Jicwood, Ltd., Weybridge, Surrey, describe the firm's extensive range of products in the field of airscrews, wind-tunnel and ventilating fans, and components in the different varieties of Jicwood. The firm has capacity for sub-contract work, in timber, sheet metal and other materials.

* * *

Flying people who are also sailing enthusiasts—and their numbers are many—will be interested in the new *Yachting World* Diary as a Christmas-gift idea. Signal codes (in colour), the Morse code, navigation data, results of classic races, design data and international safety regulations, are among the 52 reference pages. Published by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, the diary is obtainable from booksellers at 9s 2d (including purchase tax) or by post from the publishers at 9s 5d.

* * *

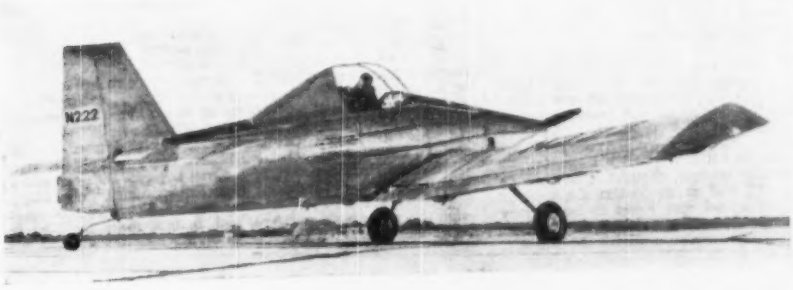
A "repeat" of S/L. John Derry's lecture on *High-speed Flying* (summarized in *Flight* last week) is to be given before the Weybridge Branch of the R.Ae.S. on Wednesday, January 10th, and not on another date inadvertently given in a recent list of forthcoming events in these pages.

* * * *

Mr. E. W. C. Wilkins, M.A., B.Sc., F.R.Ae.S., has been appointed to the Chair of Aeronautical Engineering at the Fouad I University in Cairo, and will be leaving England next month. He joined the Bristol Aeroplane Company in 1934, eventually becoming chief technician and later chief airworthiness engineer; in 1947 he was appointed Tutor in Engineering Science at Oxford University.

* * *

Noise and Vibration in Industry is the title of a brochure issued by A. E. Cawkell, electro-acoustic engineer, 7, Victory Parade, Southall, Middlesex. It summarizes experience accumulated over a number of years in the investigation, measurement and reduction of these ordinarily undesirable characteristics, and reviews some specialized equipment available for such work.



FOR THE FARMER : This single-seater, reminiscent of the "midgets" designed for the American Goodyear Trophy Race, illustrates a new approach to the problems of aerial crop-dusting, seeding and pest-control. It was designed and built by the personal aircraft research centre of the A. and M. College, Texas. The outer wing-sections have provision for internal hoppers.

BOSCOMBE DOWN "ANNUAL"

Industry and A. & A.E.E. Get Together : A Bigger and Better Airfield

At the Boscombe top table are seen (left to right) : Sir Ray Dobson, Mr. D. B. Clarke, A. V-M. J. N. Boothman, Mr. J. Hanson, Mr. W. T. Gill, A.Cdre. A. W. B. McDonald, and Mr. J. Freeman.

AN event to which members of the aircraft industry look forward each year is that known colloquially as "the Contractors' Dinner," at Boscombe Down. At these enjoyable and valuable meetings the flying and technical staff of the Aeroplane and Armament Experimental Establishment entertain the chiefs of the aircraft firms, and an ideal opportunity is provided for discussion of the successes and problems of the year.

At this year's (so far as records show) 22nd annual event, Air Commodore A. W. B. McDonald, C.B., A.F.C., presided, and, in proposing the guests, requested that all who were able to do so should provide information about the early functions, and name both aircraft and men depicted in a remarkable set of old photographic prints held by the Establishment. The material is to be sorted and edited to form a permanent record. A special welcome was accorded to A.V-M. J. N. Boothman, C.B., D.F.C., A.F.C., who first went to Boscombe at a pilot in 1921, later returned as Commandant, and now came back again as C.S.A.

Reviewing progress with expansion and rebuilding at Boscombe, A. Cdre. McDonald said that, having started the year with two-thirds of a runway and no taxi-tracks, there were now two fine runways (3,400yd and 2,600yd long by 100yd wide), taxi-tracks and some fine new buildings. These improvements, he thought, must have some effect on efficiency. The long-term plan included a new officers' mess.

Boscombe could now offer special facilities to contractors for first flights. These had cost a lot and, said the Air Commodore, he would be pleased to see them used to the best advantage. It was also good for the morale of the Establishment to see how new aircraft were shaping, particularly when one read that the Russians had superior jobs and Boscombe was still testing Vampires and Meteors.

An important step had been taken during the year to bring about closer co-operation and to share final clearance-testing of aircraft with the manufacturers themselves. This was a logical step which would cut out duplication of effort and improve efficiency. It would be put into effect early in the new year and would lead to a valuable exchange of ideas on flight-testing and instrumentation.

Finally, A. Cdre. McDonald referred to the Test Pilots' Convention, held at Boscombe for the first time this year. It had been most valuable and would be repeated. There was a great need to-day for the speeding-up of all testing processes, but this must not lead to a lowering of standards.

A.V-M. Boothman, Controller of Supplies (Air), replying for the guests, recalled A. and A.E.E. pioneers and his own earlier days with the Establishment, to which he was posted nineteen years ago almost to the day.

Mr. J. Freeman, M.B.E., Parliamentary Secretary to the Ministry of Supply, assembling his facts—and his anecdotes—in a characteristically masterly manner, thought it remarkable that aircraft manufacture still had as its leaders the creators of the industry. The year ahead was likely to be a very different one from that to which he had referred on a similar occasion last year. It would be a very busy one for the industry, and there was no longer the same money-shortage for aircraft.

Referring to machines now in service, Mr. Freeman said that there were some in the world which were better than those we had, but at what point must a halt be called on improvement and the start of production be ordered? He believed that the timing would still prove to have been right in this country, and our new aircraft were likely to be better than all others. We dare not skimp the time spent in perfecting our products, but a month saved now would been an extra month on the time of peak production. Boscombe, Mr. Freeman believed, was already the finest establishment of its type in the world; it was necessary to maintain the conditions to keep it so.

Mr. W. T. Gill, President of the S.B.A.C., said that the industry now had a sight of the problems which were to be put to it. What was wanted was the right product at the right time, and at the right price. The industry rejoiced to see the facilities gradually accumulating at Boscombe.

Before the dinner came to an end, there was a call, as usual, for a few words from Sir Frederick Handley Page.

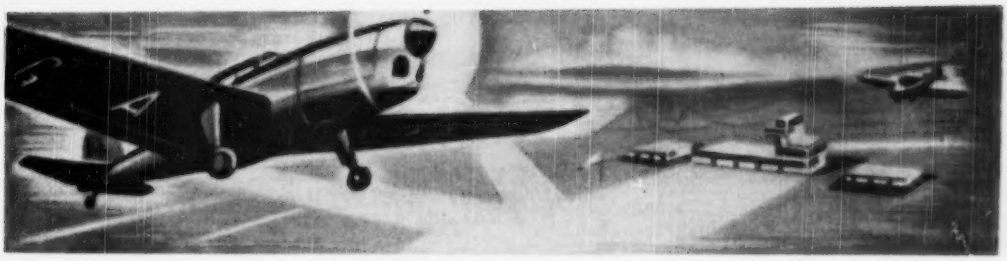
OTHER PLANETS

"The Conquest of Space." Paintings by Chesley Bonestell; Text by Willy Ley. Sidgwick & Jackson, 44, Museum Street, London, W.C.1. Price 18s.

THIS book does not provide the answer to what the Sunday newspapers call "The Flying Saucer Mystery," for it is concerned with what we on earth have been able to learn of other planets, and not with whether another world is "watching" us. Indeed, the most cursory glance through its pages makes it quite obvious that a race of "little men" inhabiting any other planet in our solar system would need either asbestos skin or refrigerated arteries, depending on where they lived. Here, for example, is Mr. Ley's description of Jupiter: "Its atmosphere and its 'surface' may still undergo violent changes, with chemical explosions of hydrogen, caused possibly by sodium or other chemical reactions which are not in our low-pressure chemistry . . . amid cliffs of permanent ice rising from a sea of temperarily liquid ammonia." Mr. Bonestell's impression in colour of the result would make a fitting backcloth for Dante's *Inferno*.

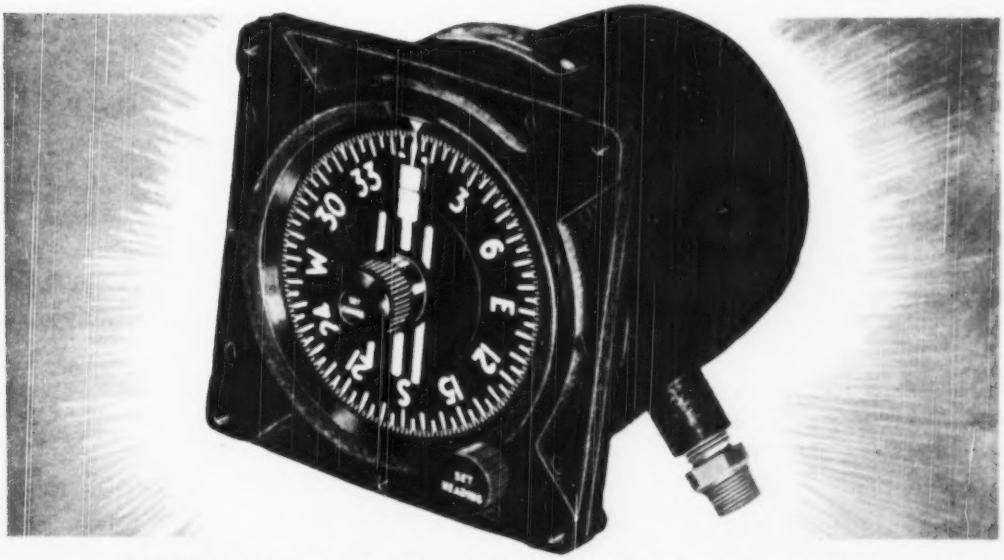
Not all the paintings are as frightening; those of ringed Saturn, for instance, are as beautiful as they are awe-inspiring. Their detail is such that one can almost imagine that Mr. Bonestell must have travelled by private space-rocket to Mimas or Titan to draw them. Nor are they fantasy, for everything in this book is based on fact, as far as we know it at present, corroborated by some of the greatest astronomers in America.

In his introduction, Ley tells how Bonestell learned to work out and draw exactly what we believe Mars to look like from Deimos, its farthest moon, at a visual angle of 30 degrees and at a precise phase of rotation: from that moment, one no longer doubts the authoritativeness of the paintings. The text maintains the same high standard, and, in fact, there could be no better introduction to cosmology or the new science of interplanetary flight than this book. J. W. R. T.



Smiths Air-driven Directional Gyro

To meet the need for a less restricted direction indicator, SMITHS have recently developed this air-driven directional gyroscope. The instrument has freedom of the inner gimbal ring up to ± 85° so that the gyro can only be 'toppled' when a loop or roll is made *directly* about the axis of the inner gimbal ring. The instrument has the additional advantage of being identical in card presentation with the latest Air Ministry and Airline specified gyro-magnetic compasses. When installed in training aircraft, the pupil is made familiar with the presentation used in operational aircraft. Where an air-driven indicator is required as a standby to the electrically operated gyro-magnetic compass, in airline use, the similarity of presentation is again a great advantage. The card can be reset with the magnetic compass under any flight conditions or on the ground, without caging the gyro and the course pointer is operated independently through a reducing gear that facilitates accurate setting by the pilot.



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WATER-BASED FIGHTERS

A wake of spray and steam is left behind as a Saunders-Roe S.R./A.1 (2 Metrovick Beryls) takes its departure from the waters of the Solent.

An Outline History—and a Survey of Modern Possibilities

By H. F. KING, M.B.E.

THOUGH marine aircraft have been successfully employed for air combat in both world wars, and numerous floatplane and flying-boat fighters of real merit have been tested in the years of peace, the achievements and potentialities of such aircraft are not widely known. This assertion is borne out by a recent pronouncement in an American technical journal that only one water-based machine on record—the pre-war Macchi-Castoldi racer—has proved faster than the new turboprop Convair XP5Y-1 anti-submarine and transport flying boat. Evidently the writer responsible for this contention was not present at the S.B.A.C. Display of 1948, when Geoffrey Tyson, in the Saunders-Roe S.R./A.1 jet-propelled fighter flying-boat, astonished an international audience with one of the most dramatic and significant demonstrations of high-speed aerobatics and inverted flight ever witnessed.

The story of water-based fighters, culminating in such remarkable machines as the "A.1" and the projected Convair Skate, abounds in surprises and parallels, and a brief study may rectify misapprehensions such as that instanced above.

Archetype of all fighter seaplanes—certainly those of British make—was the Sopwith Tabloid "Scout," adapted as a floatplane for the Schneider Trophy Contest at Monaco in April, 1914. In this remarkable little biplane, with its 100 h.p. Mono-Gnome engine, Howard Pixton secured the Trophy for Britain, in face of formidable French competition, by averaging 86.8 m.p.h. Originally, the "Schneider," as the machine came to be known, had a single main float, but in this condition it proved unstable on the water and, as time did not allow complete redesign of the undercarriage, conversion to twin floats was expediently effected by cutting the original float in two along the centre-line and closing-in the resultant halves.

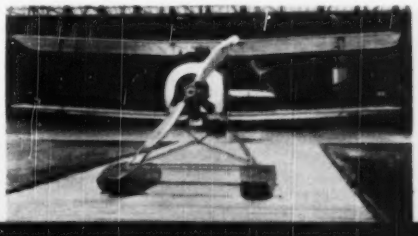
It is not inappropriate to remark here that Pixton's splendid victory passed almost unnoticed in the English daily Press, though on the Continent it created a deep impression and was counted a stern threat to the prestige of French aviation.

Sopwith twin-float seaplanes bearing the name "Schneider" or "Baby," and generally resembling Pixton's machine, were ordered for fighting and reconnaissance work, and continued in production, in various forms, until the Armistice of 1918. Large numbers of a structurally modified type were manufactured by the Blackburn Company (this variant was often called the Blackburn Baby) and a variable-camber development, built by Fairey, appeared under the name Hamble Baby. At the Admiralty's Marine Experimental Establishment on the Isle of Grain a set of high-lift staggered wings was fitted experimentally to yet another development, known as the P.V.1. Various original floatplane designs—exemplified by the Westland N.16 and N.17, powered with a 150 h.p. Bentley rotary and armed with one Vickers and one Lewis gun—materialized late in the 1914-1918 war. A certain interest attaches to the Westland machines in that the N.16 had the conventional World War I arrangement of two short main floats and a tail float, whereas on the N.17, as on many modern seaplanes, the main floats were lengthened and the tail float eliminated.

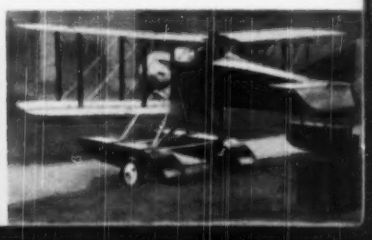
Surprisingly enough, small flying-boats of high aerodynamic efficiency are almost as old in British air history as are the floatplanes already referred to; and among them no design is more remarkable, having regard to the date of its inception, than the Pemberton-Billing tractor machine, shown at Olympia in 1914. Though itself unsuccessful, it laid down the pattern for later machines of Supermarine make, among which another "Baby" (an exasperatingly recurrent appellation in British aircraft nomenclature!) was perhaps the most notable. A photograph herewith shows what a remarkably compact design this was, with its span of only 30½ft and length of 26ft. The Hispano-Suiza engine, of a mere 150 h.p., gave a speed of nearly 120 m.p.h. and the

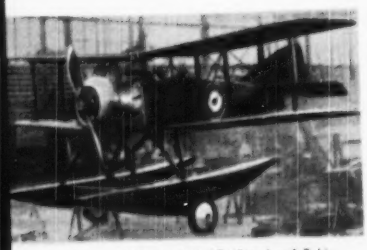
Sopwith Tabloid (Mono-Gnome).

Sopwith-Blackburn Baby (Clerget).

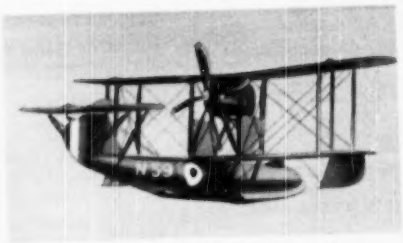


Westland N.16 (Bentley A.R.1).



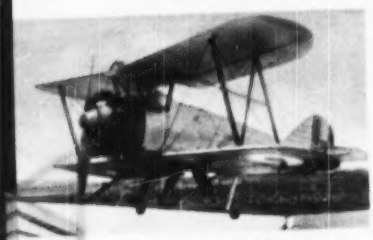


Westland N.17 (Bentley A.R.1).

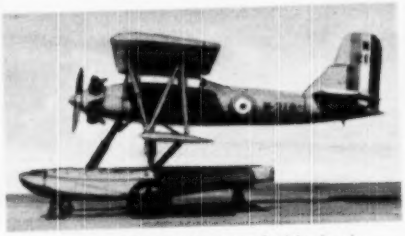


Supermarine Baby (Hispano-Suiza).

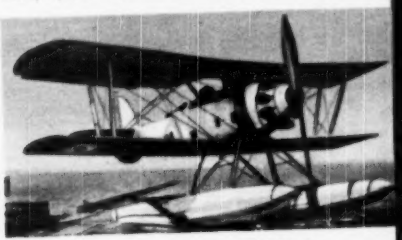
Fairey Flycatcher (Armstrong Siddeley Jaguar).



Parnall Plover (Bristol Jupiter).



Avro Avocet (Armstrong Siddeley Lynx).



Short Gurnard with twin-floats (Bristol Jupiter)

WATER-BASED FIGHTERS . . .

landing speed was less than 60 m.p.h. A wing loading of 7.5 lb/sq ft allowed a high degree of manœuvrability.

The Supermarine Baby was the progenitor of the Sea Lion II, which regained the Schneider Trophy for Great Britain in 1922 and established a world's speed record of 145.7 m.p.h. The Sea Lion had a fighter counterpart in the Sea King II and both machines are said to have been capable of every aerobatic manœuvre expected of a landplane fighter. But times were unpropitious, and with the Sea King it was the still-familiar story of "good aircraft; but—sorry—no orders."

Until the introduction of the Gloster Sea Gladiator shortly before the second world war all British shipborne fighters—of which the Fairey Flycatcher and Hawker Nimrod and Osprey are the best-known examples—were designed to take interchangeable wheel or float undercarriage. One version of the Flycatcher, in fact, was built as an amphibian, with non-retractable wheels housed in the twin floats.

In this country the small flying-boat went out of favour for fighting purposes until jet propulsion made possible the conception of the Saunders-Roe S.R./A.1. On the Continent, however, various designers persevered with the boat formula, and a surprising number of quite efficient little fighter flying-boats made their appearance in Italy and France. Certain of these (like the Supermarine Sea King) boasted kinship to Schneider racers, and notable among the later models was the cannon-armed Potez 453, a 200-m.p.h. design intended, like many others of its breed, primarily for shipboard use. By 1936—the year in which this Potez appeared—British interest in such machines was at a low ebb. The R.A.F. expansion scheme included no such type, and there were no further developments until 1940, when the campaign in Norway disclosed our desparate need for fighters capable of operating from the sheltered waters of lakes and fjords. Designs were thereupon put in hand for twin-float undercarriages to suit the Spitfire and Hurricane but Norway fell before either conversion could be flown and

Short Gurnard amphibian (Kestrel).

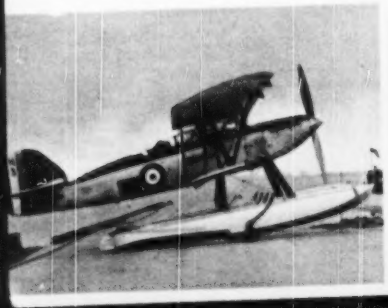
Fairey Firefly III (Rolls-Royce Kestrel).

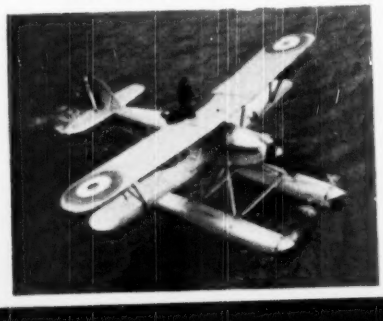
Hawker Nimrod (Rolls-Royce Kestrel).

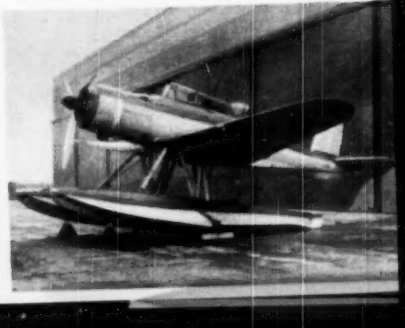
Fairey Fleetwing (Rolls-Royce Kestrel).

Hawker Osprey (Rolls-Royce Kestrel).

Blackburn Roc turret fighter (Bristol Perseus).







Potez 453 cannon-armed single-seater flying-boat (Hispano-Suiza)

the Hurricane project was abandoned. Work on the Spitfire floatplane, however, went ahead, and Mr. J. Smith has described its evolution in his famous paper, *The Development of the Spitfire and Seafire*. At first, he relates, a Spitfire 1 was used, and as time was limited twin Blackburn Roc floats were installed. Having a reserve buoyancy of 130 per cent, these appendages did not lend themselves at all well to adaptation to the Spitfire. Nevertheless, a conversion was completed, though early termination of the Norwegian campaign, and the urgent need of aircraft for the Battle of Britain, caused it to be restored to standard landplane form before it flew.

These setbacks notwithstanding, the fighter-floatplane requirement was not allowed to drop, and in 1942 a second floatplane—basically a Spitfire 5—was produced. Designed by Supermarine, the floats had a reserve buoyancy of 90 per cent and were mounted on cantilever struts attached to the mainplane spars at a distance of 5ft from the centreline of the aircraft. Fin area was added under the rear of the fuselage to counteract the destabilizing effect of the floats, and the engine air-intake was extended forward to prevent the entry of spray. The handling characteristics of this machine both in the air and on the water were good, and its speed was only 30 m.p.h. less than that of the equivalent landplane. Subsequently a Mk. 9 was converted, using the same type of undercarriage, and a number of these floatplanes were manufactured.

Largely due to concentration of resources upon land-based and carrier-borne aircraft, no quantity production of seaplane fighters was undertaken in this country. Interest was not altogether dead, however, and to specification N.2/42 the Blackburn Company submitted designs for a floatplane possessing some unusual characteristics. Most notable of these was the retractable planing bottom—a feature patented by Major J. D. Rennie and first incorporated in the B.20 twin-engined military flying-boat completed and flown at Dumbarton in 1940. The lateral stabilizing floats were likewise retractable and, as will be seen in the accompanying sketch, the machine would have presented a very clean appearance in flying trim. The engine was a Napier Sabre, driving a contra-rotating airscrew, and the standard fighter armament of four 20 mm guns was built into the wings.

Having foreseen that fighter seaplanes would be valuable in their Pacific campaigns, the Japanese built and operated, in considerable quantities, two first-class types. Rejoicing in the Allied code-names Rufe and Rex, these had a single main float and lateral stabilizing floats.

Though the Germans had built fighter floatplanes—notably the He51—during the period of their rearmament, no specialized machines of this sort were operated by them in the last war. A singular coincidence, however, is discernible in German floatplane operations during both world wars. In the first, it was their practice to use reconnaissance-type floatplanes (principally of Friedrichshafen and Brandenburg design) against the British long-range flying-boats engaged on anti-submarine and other patrol duties, and this same practice was re-instituted in the last war, when Arado Ar196 reconnaissance floatplanes, mounting increased armament (two 20 mm Oerlikon guns), were employed in attacks on our Sunderlands.

Having thus briefly noted the vicissitudes through which water-based fighters have passed, and before turning to the present-day S.R./A.1 and the projected Convair Skate, some general observations on modern flying-boat fighters seem appropriate.

Especially significant, in affording some explanation of disappointments borne by various manufacturers in the past, is the admission by Saunders-Roe, Ltd., makers of the still-unique "A.1," that only the advent of the turbojet enabled them to develop their flying-boat-fighter ideas to the full. Formerly, their technical staff had found that, in order to provide water clearance for the airscrews, shaft-drives and other mechanical complications were required.

Expounding the merits of flying-boat fighters, the company points out that the Pacific campaigns afforded proof that, though land-based fighters fulfilled their operational roles successfully once landing strips and base facilities had been established, they were very costly in men and materials. Furthermore, unless carrier-borne aircraft were available, the establishment or capture of land bases was most difficult. Carriers and their attendant vessels were, in any case, very vulnerable to enemy sea and air forces.

On the other hand, the company asserts, the fighter flying-boat is independent of fixed bases, for any sheltered stretch of water permits it to operate; thus, the transport of a mass of airfield constructional equipment is rendered unnecessary and the time spent in preparing for action can be greatly reduced. A further important advantage claimed is that the jumping-off point of an air strike-force can be brought much nearer to the objective than would be possible with shore-based aircraft.

Developing their argument, Saunders-Roe maintain that, as seaborne operations have often been a prelude to invasion, the fighter flying-boat could undoubtedly play an important part in any future assaults of this kind. While they recognize that jet aircraft are restricted in range, due to their inordinately high fuel consumption, they hold that the fighter flying-boat can nullify this difficulty by bringing its take-off point closer to the operational scene.

Another weighty argument advanced by flying-boat protagonists generally (and this concerns classes other than fighters) is that its take-off and alighting area is indestructible. Furthermore, it might often be possible, by using suitable inland lakes or fjords, to defy enemy reconnaissance aircraft seeking the precise location of a base; and even

Below are a Brandenburg floatplane and an Arado Ar 196—comparable German types used respectively in the First and Second World Wars.

The dainty and efficient Supermarine Spitfire seaplane, the last of a long and distinguished line of British piston-engined floatplane fighters.

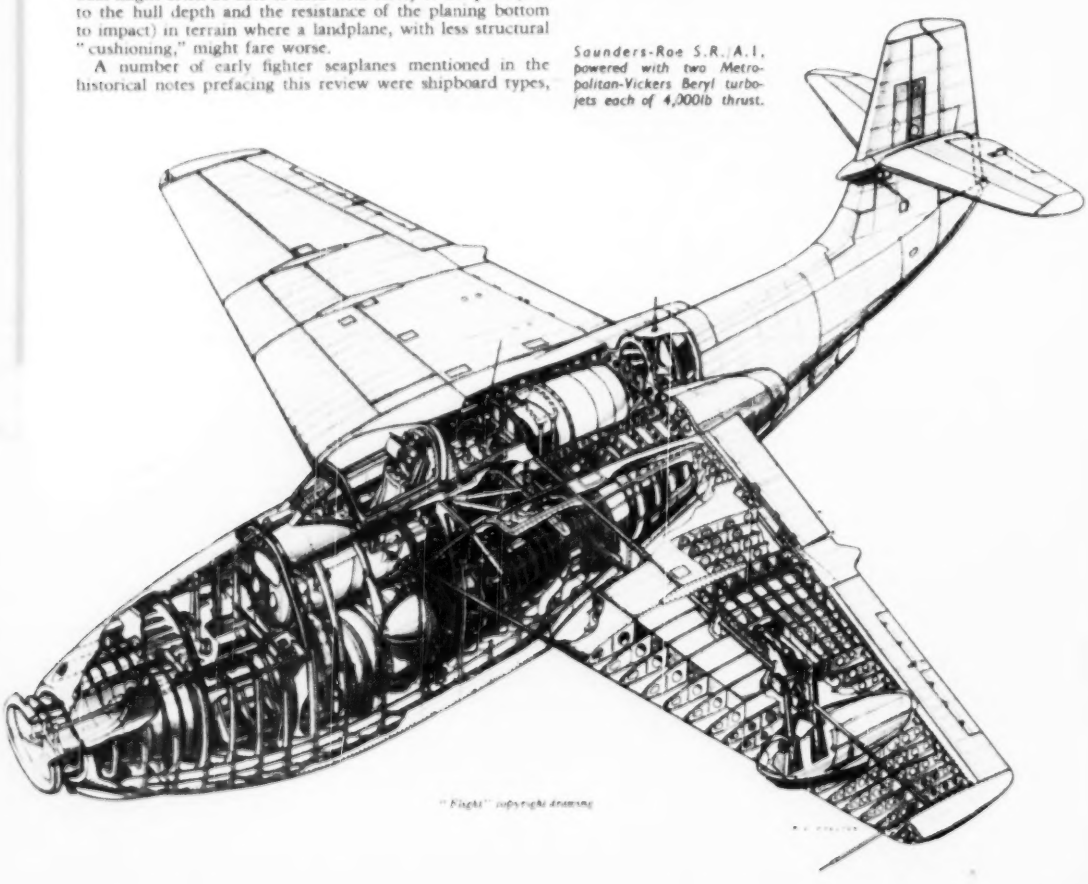
WATER-BASED FIGHTERS . . .

should the base be detected, it might be a relatively easy matter to transfer it to new waters.

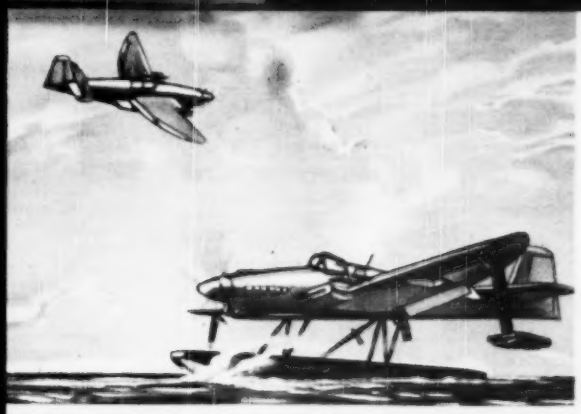
The point has rightly been made that enemy action not infrequently necessitates a forced alighting on water—a proceeding which would generally be far more hazardous for the landplane than for the flying-boat. Conversely, a flying-boat might often be able to land with safety to the pilot (due to the hull depth and the resistance of the planing bottom to impact) in terrain where a landplane, with less structural "cushioning," might fare worse.

A number of early fighter seaplanes mentioned in the historical notes prefacing this review were shipboard types, suitable—with wheel or amphibian undercarriage—for deck-landing, or—with float or amphibian gear—for catapulting and lowering and hoisting by derrick; but little is heard to-day of the fighter flying-boat's adaptability for operation from ships. The least fertile imagination, however, can envisage a special "mother ship" (a modern counterpart of the old *Campania* seaplane tender), fast enough to transfer herself promptly and effectively from one scene of operations

Saunders-Roe S.R./A.1, powered with two Metropolitan-Vickers Beryl turbo-jets each of 4,000lb thrust.



"Flight" copyright drawing



The principal features of the Blackburn project for a seaplane fighter with a retractable planing bottom are depicted in this specially prepared "Flight" sketch. The engine was to have been a Napier Sabre.

to another, but fully equipped for the maintenance, rearming and refuelling of her brood. Furthermore, it is not uninteresting to speculate on the possibilities of a flying-boat capable of operating not only from water but from a flexible deck of the type now under development by the Royal Navy. Vice-Admiral M. J. Mansergh, C.B., C.B.E., Fifth Sea Lord and Deputy-Chief of Naval Staff (Air), in his recent lecture on naval aircraft before the Royal United Service Institution, referred to the especial value of such aircraft in training, for, as he pointed out, flying could continue uninterrupted while a carrier was in harbour.

The germ of the idea could be discerned in tests with Fairey IIIF and Flycatcher floatplanes which landed aboard H.M.S. *Furious* during 1927. The floats of the Flycatcher had been strengthened on the underside, but were nevertheless hardly strong enough for deliberate abuse. Take-off and landing runs, however, were well within the deck space of the *Furious*; the best take-off run was 91ft, and the shortest landing run, 170ft.

Certainly the jet fighter boat appears to be an eminently desirable type, from numerous points of views, though its most ardent supporters do not suggest that it could—or should—oust its land-based counterpart entirely; they do, however, contend that any widespread war would present situations (especially in difficult terrains) which could best be met by the water-based machine.

On the score of performance it is not everyone who sees eye-to-eye with those authorities who aver that aerodynamic and structural techniques already allow the construction of a transonic or supersonic flying-boat which would not be inferior in performance and fighting qualities to the finest contemporary land-based machines. As a fighter the S.R./A.1 is already out of date, but trials with three prototypes have endowed Saunders-Roe, Ltd., with experience of unparalleled value which could certainly bring forth a machine capable of speeds far in excess of 600 m.p.h. Present indications are, however, that the flying-boat fighter is best suited to engage bombers and strike aircraft rather than specialized home-defence fighters. Certainly there are many people who would doubt that any fighter flying-boat capable of engaging the Hawker P.1081 or Supermarine 535 on equal terms, could be flying to-day, no matter what technical and financial resources had been brought to bear on its development.

But fighters of the class under discussion are not restricted in application to air combat. By their very nature they are flexible not only in respect of bases, but in their operational employment also; numerous seaplane fighters of past years have been fitted to carry a light bomb load and the S.R/A.1 is a formidable ground-attack aircraft. A hypothetical fighter/attack flying-boat of the near future might have the following characteristics: gross weight, over 25,000lb; wing- and tail-surfaces, swept-back; power plants, two Rolls-Royce Avon or Armstrong Siddeley Sapphire (total thrust, say, 16,000lb); built-in armament, four 30 mm guns; external stores, four 1,000lb bombs, or sixteen 95lb R.P.s, or four large-calibre R.P.s or drop-tanks; maximum speed, about 650 m.p.h.; ultimate range, over 2,000 miles. For later machines various configurations, including the delta-wing, can be envisaged.

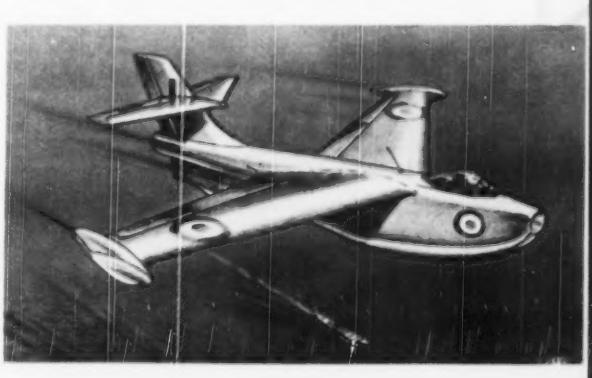
Difficulties attending the perfection and introduction into service of jet fighter flying-boats appear to be associated largely with water handling; but Sir Arthur Gouge, vice-chairman and chief executive, Saunders-Roe, Ltd., has expressed his confidence that a suitable scheme can be evolved. Already the Saunders-Roe automatic mooring scheme enables the pilot to pick up moorings without leaving his cockpit and without external assistance.

As already intimated, the only fighter flying-boat in existence to-day is the Saunders-Roe S.R./A.1 (to Specification E.6/44), originally intended for the war in the Pacific and, to that end, planned for immediate quantity production. The course of the Pacific war caused the production programme to be retarded and, eventually, only three "A.1s" were completed. On July 16th, 1947, Mr. Geoffrey Tyson made the historic first flight. Though accidents to two of the three examples have interrupted the programme of trials, the remaining machine is now flying, after detail modifications, at Cowes, Isle of Wight.

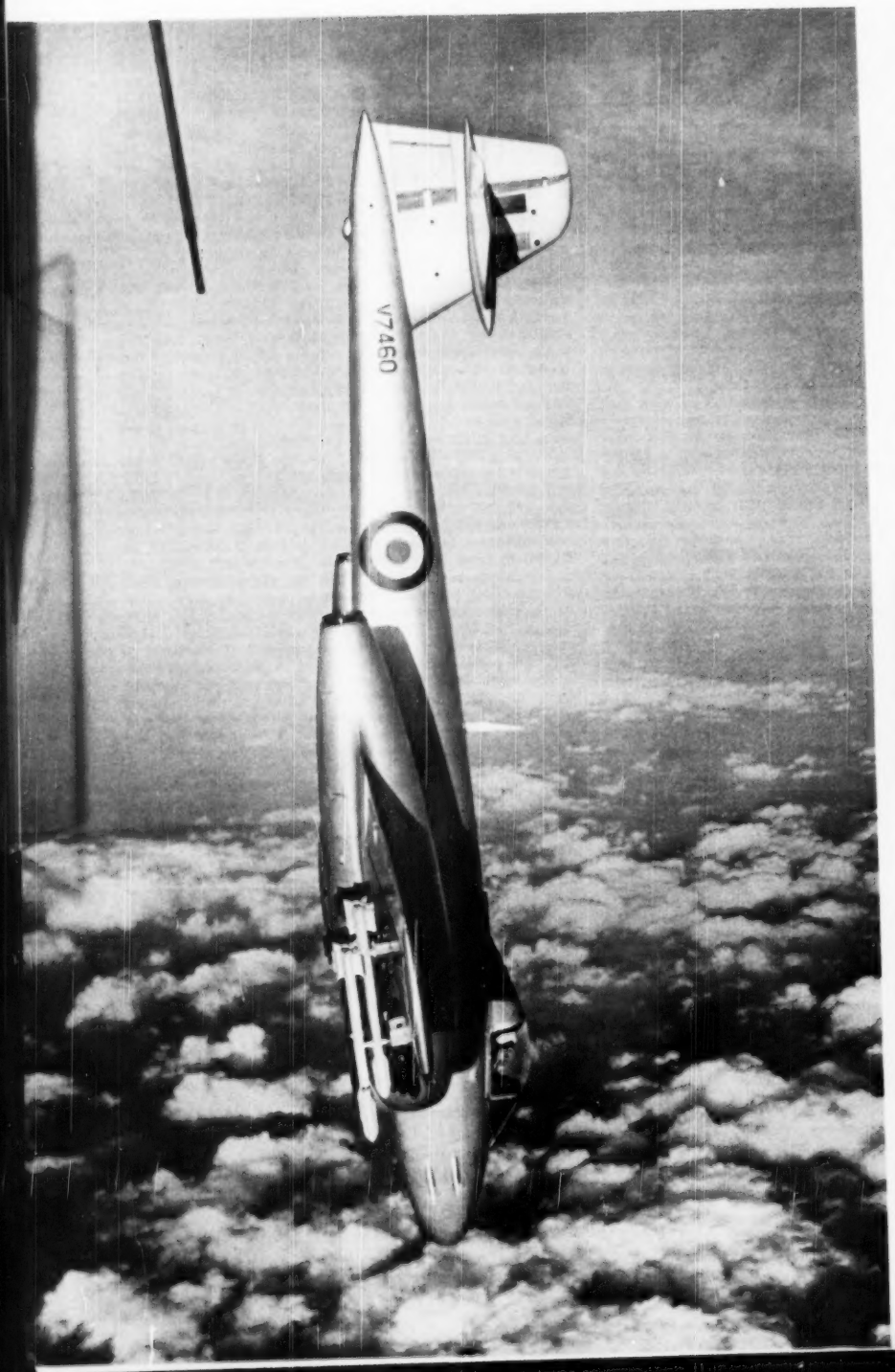
Salient features of the S.R./A.1 are apparent in the *Flight* sectional drawing reproduced here. The turbojets at present installed are Metropolitan-Vickers Beryls, each of 4,000 lb thrust, but development work on this unit has been discontinued and, should production of the S.R./A.1 be ordered, new power units would have to be found. An order for the aircraft in its present form, however, is most unlikely, though a possible development of the "A.1" theme is illustrated on this page. It is emphasized that the aircraft depicted is merely a project and that it exists only in model form. Notable features are the swept wing and tail surfaces, faired step, and lateral stabilizing floats retracting on to the wing tips, as on the Princess flying-boat.

No post-war Continental or Soviet designs for fighter flying-boats are known to exist, but at the Convair plant in America a team has been engaged for some years (under the cover-name Project Skate) on experimental work preparatory to the construction of an ultra-high speed flying-boat for the U.S. Navy. Design data on the S.R./A.1 are known to have been supplied to America and, writing in our contemporary, *Aviation Week*, Mr. Alexander McSurely considers that, barring a delay due to more pressing requirements, a Convair prototype might be flying within two years. Already the Skate is said to have passed through at least nine major model changes and particulars of the latest of these are not disclosed. The American writer makes reference to certain basic ideas which are soon expected to enable flying-boats to achieve parity in speed with even the fastest land-based machines. These include increased ratio of hull length to beam and the very careful blending of hull and wing. Retractable spray-suppression strips, or "dams," which obviate all flares and sharp chines, are among other features envisaged for the flying-boat fighters of the future.

Saunders-Roe suggestion for a twin-jet flying-boat fighter—developed on the S.R./A.1 theme. Note the faired step and tail jet orific.



THE AGILE



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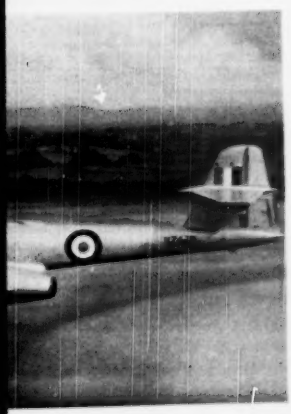
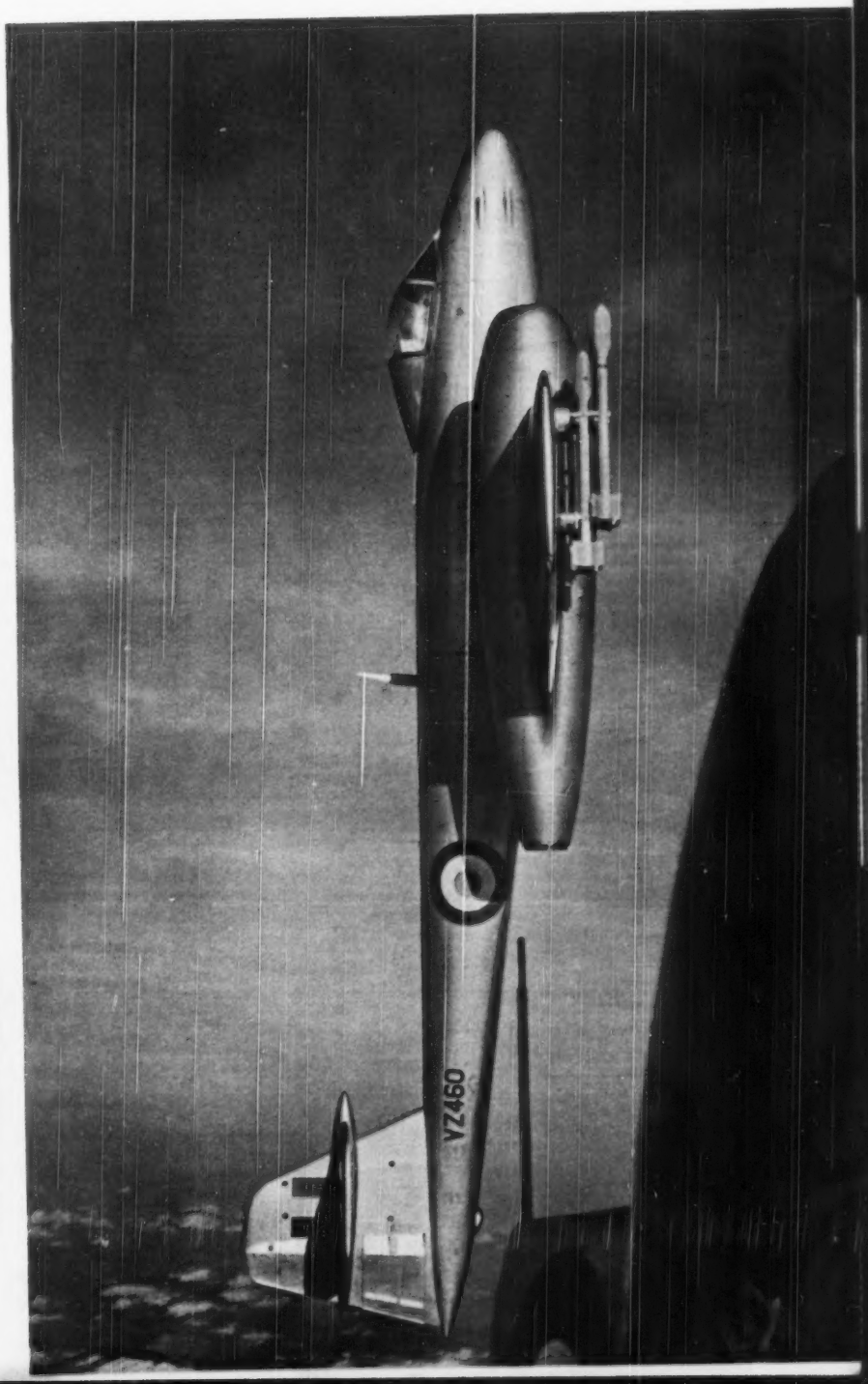




PILOTING A FREE BALLOON

Flight photograph

Translating Aerostatic Principles into Practice: What the Efficient Aeronaut Must Know

By . . .
LORD VENTRY

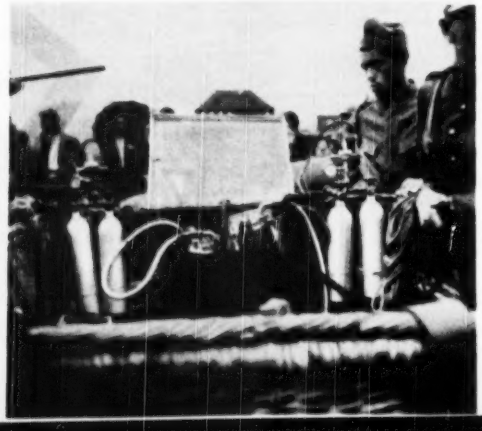
Unless and until there is a revival of free ballooning in Britain the subject of this article must necessarily be largely of academic value: but that fact makes it no less interesting. What may surprise the present "heavier-than-air" generation, many of whom have never even seen a spherical balloon, is that a successful ascent (and landing) is not just a matter of standing in the basket and casually emptying a sandbag or pulling a valve-line; on the contrary, the balloon is, as the author says, a temperamental craft, and one that calls for real skill and understanding in its handling. Lord Ventry is an authority on lighter-than-air aviation, and holds a current balloon licence.

FOLLOWING the recent description in *Flight* (November 16th) of the airship *Bournemouth*, now under construction, some notes on another branch of "lighter-than-air" aeronautics—the flying of free ballons—may be of interest: the association is strong, in that free ballooning always used to be considered an important part of an airship pilot's education.

Free balloons have wills of their own, and a careless or inexperienced pilot is likely to become a mere passenger. The would-be pilot must therefore study aerostatics, and he will then understand far better why a balloon suddenly becomes temperamental. Free ballooning is indeed the best way to learn about aerostatics.

First, then, lift. The gross lift is the difference between the weight of the gas and the air displaced. The nett, or disposable lift, is the difference between the weight of the balloon plus its gas and the weight of air displaced.

The weight of air and gas, however, varies with pressure and temperature. The higher the barometer, the lower the temperature, the less the humidity, and the greater the gas purity, the greater the lift. A balloon, therefore, will usually have a greater lift in winter than in summer. When in flight, however, and provided air and gas are at the same temperature and no gas is lost, changes in pressure and temperature have no effect on lift.



The modern touch: oxygen bottles and frame aerial in the basket of a Swiss balloon. Note the outboard map-table.

"*Flight*" photograph

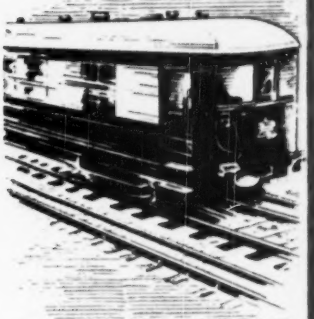
The only spherical-balloon flights in this country since the war have been made by the French balloonist M. Charles Dollfus, seen here ascending from an R.Ae.S. Garden Party. The "quilted" appearance of the envelope is caused by the fabric bulging through the meshes of the net.

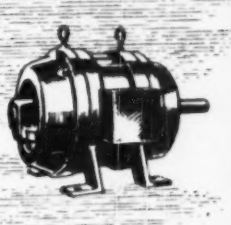
A spherical balloon leaves the ground with a certain lift. It rises until its own weight is the same as the weight of air it displaces. Usually, however, a certain momentum is obtained, and this causes the balloon to overshoot the equilibrium point. It continues to rise, stops, and then starts to fall. The more the original lift, the greater the altitude attained before this first run-down begins. Under these conditions, however, less ballast can be carried and more gas is lost, thus shortening the flight. This method is the usual practice with very large balloons on stratospheric flights, for otherwise an enormous quantity of ballast would have to be carried.

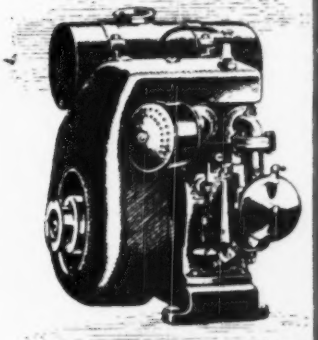
As the barometer falls approximately one inch per thousand feet, it is easy to work out the equilibrium point for a given discharge of ballast, assuming that air and gas temperatures are the same. For practical purposes it is assumed that barometric pressure at m.s.l. is 30in. Therefore, and assuming that the balloon leaves the ground totally filled, about one-thirtieth of the gas, and also of the lift, is lost per 1,000ft. In reality it is a little less.

The weight of the balloon, its gas and crew must be known. If, for example, 3,000ft is the desired objective three-thirtieths of the gross lift must be discharged at the start. The weights of 1,000 cu ft of gas and air are assumed to be 75 lb and 5 lb respectively, at 30in pressure and 60 deg F. Thus, under these assumed conditions, 1,000 cu ft of hydrogen lifts 70 lb. For practical purposes, however, it is safer to assume a lift of 68lb/1,000 cu ft.

Normally the balloon ascends full. In this case the expanding gas overflows through the open neck and, as gas is lost, so is lift. If the balloon is flabby and air and gas temperatures are the same there is no loss of lift until the balloon is full. In this case the weight of air displaced decreases at the same rate as the volume of air displaced increases, so the lift does not alter.







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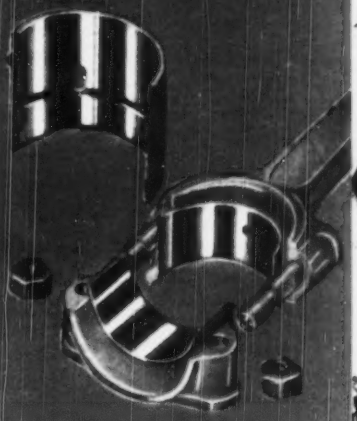

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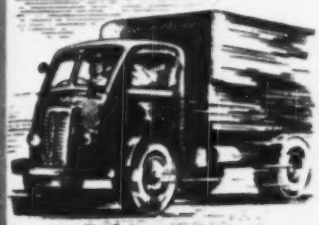

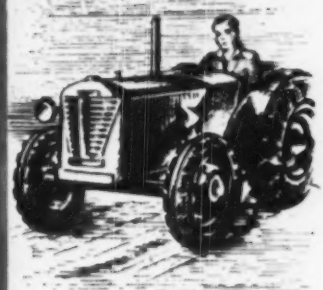

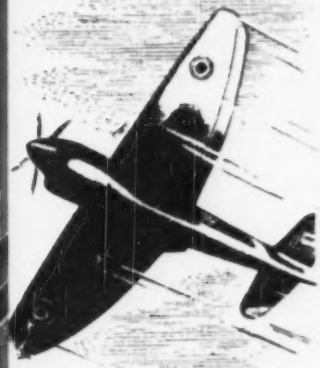

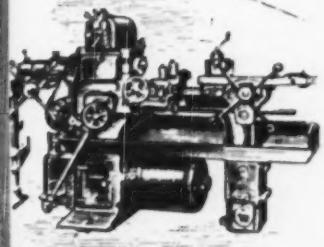

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PILOTING A FREE BALLOON . . .

"Ballasting-up" before flight and before landing is most important. It is by such means that the pilot retains control over the balloon at two vital moments.

The "ground officer" is responsible for the first ballasting-up; the ground party is under his control, and its members must maintain silence and obey his orders instantly. When the balloon is vertical and ready for flight he gives the order "hands off," then "hands on." If the balloon is heavy it remains on the ground. Some ballast bags are taken off and the process repeated until the pilot is satisfied that the lift is correct. Then the neck is untied. Before the final "let go all" is given a note should be made of the remaining ballast and entered in the log. On no account must the ground party give the basket an upward push. This only gives a false lift and hinders the pilot. Much time is saved, and more accuracy attained, if a rough calculation is made beforehand showing how "light" the balloon must ascend to gain a given altitude. No pilot should ascend unless he is quite ready and satisfied with his lift.

Knowing the approximate height at which the balloon will be in equilibrium, the pilot keeps a sharp eye on his rate-of-rise-and-fall indicator. Tissue paper is also very useful: small pieces are thrown out, and give an indication as to whether the balloon is rising, falling or in equilibrium. The statoscope is another guide.

The great point is to leave the ground with just sufficient lift to clear all obstacles. Hence an open and clear space, with plenty of room down-wind, is far preferable to, say, a gas works with its high gas containers. If the start has been managed properly, and the balloon correctly ballasted-up, the initial rise can be slow. There is then little momentum and the first run-down can be checked with a very small expenditure of ballast. The higher the wind the greater must be the initial lift.

When the balloon starts to descend it immediately becomes flabby. Then, if air and gas are at the same temperature, it can rise again without losing lift. When it is full, the so-called "pressure height" is reached. If it continues to climb gas is again lost and it again descends. The pressure height increases with each rise, and a carelessly piloted balloon makes a series of rises and falls, until both ballast and gas are exhausted and the flight comes to a premature end.

A good pilot, therefore, aims at keeping his balloon as nearly in equilibrium as possible. This, however, is easier said than done.

A balloon has only to become a few ounces heavy or light for its equilibrium to be upset, and it is essential to carry plenty of ballast. Altitude and length of flight, indeed, depend on this. If approximately one-thirtieth of the lift is lost per 1,000ft and the desired maximum altitude is, for example, 10,000 ft., one-third of the lift will be lost. At least one-third of the gross lift must therefore be allotted to ballast, while more must be carried in reserve.

So far we have assumed that air and gas temperatures are always equal. In practice this is seldom the case. The hydrogen in the envelope is warmed directly by the sun, and the surrounding air by radiation from the ground. The gas, however, heats up some seven times faster than the air; and when the gas thus "superheats," and the balloon is full, there is a gain in lift equivalent to the weight of gas lost. If the envelope is flabby, there is a gain in lift equivalent to the weight of additional air displaced by the expanding gas.

All this must be allowed for, otherwise the balloon may lose so much gas that it becomes very heavy, and a fast downward run then becomes difficult to stop. Hence the need for plenty of ballast.

If the balloon is full, and when air and gas are at the same temperature, a rise in temperature means a loss of lift. Gas is then lost through expansion and a fixed volume of gas displaces air, which is lighter through expansion. If the balloon is flabby, lift does not alter, for the gas expands at the same rate as the weight of air displaced decreases.

Besides watching his instruments, therefore, the pilot also keeps an eye on the sun. If, for example, an undesired rise occurs and the sun is about to be clouded over, there will probably be no need to valve gas. In the same way, the sun "emerging from" a cloud may check a run down. The nearer the balloon is to equilibrium the less the ballast and gas that need to be lost in checking vertical movements. The quicker the pilot is, too, the less ballast he need jettison to stop a fall. If he hesitates, and allows the balloon to achieve a momentum the more ballast he must let go; and the same applies to upward runs and the gas valve. There is always a time-lag, however, and the pilot must not expect that a fall will be checked immediately.

When near the ground thermal currents must be allowed for. When passing over hot sand, for example, or short grass, rising currents may cause the balloon to rise, especially if it is in equilibrium. When passing over water or trees, the balloon starts to descend.

Cloud Effects

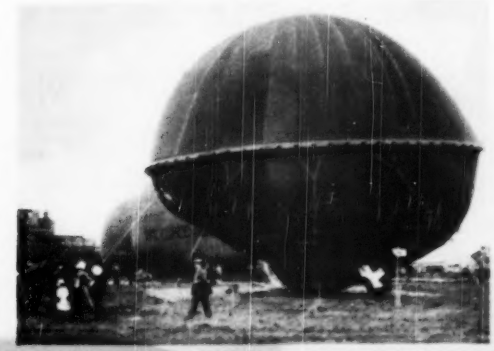
When a balloon is flying above the clouds with a clear sky overhead the sun causes much loss of gas. When descending, the balloon often "bounces" on the clouds, for heat is radiated upwards from them, and expands the gas. Once in the clouds the gas cools and shrinks, and, to stop a fast downwards run, ballast must be thrown out. Here, again, delay means gathering momentum and a waste of ballast. As a balloon descends it normally meets increasing air temperatures, and this helps the downward run.

At night it is much easier to achieve equilibrium. Temperature inversions, however, may be encountered; these cause a temporary loss of lift, for the air is then cooler than the gas. This is known as a "latent lift," and the pilot must be ready with a little ballast to stop a run-down. If a thermometer is carried the pilot knows better what is happening, and so saves much ballast.

Landing is an art in itself, and a pilot can be judged by his landings. Jettisoning a large quantity of ballast at the last moment points to bad piloting. Every landing is made in a different place, and under varying conditions, so much experience is necessary.

The late Mr. Griffith Brewer, who was one of the most expert British pilots, used to tell his pupils in the R.N.A.S. to ballast-up at about 500ft. If a balloon can be brought into equilibrium at that height it certainly makes landing much easier. If the weather is windy it is best to land in a sheltered spot—behind a wood, for example—and in that case the rip panel should be pulled out before hitting the ground. This prevents an upward bounce, and empties the balloon in a few seconds. In a strong wind the red

An unusual type of balloon, with netless envelope, flown by a Swiss competitor in one of the Gordon Bennett races.



Ground party handling the basket of a 170,000 cu ft balloon (pilot, the late W/C. C. M. Waterlow) operated by the R.N.A.S. in 1917.

PILOTING A FREE BALLOON . . .

rip-cord can be pulled at tree-top level. Passengers must hold on tightly, and bend their knees, and on no account must they leave the basket until ordered to do so.

In calm weather the balloon is valved down. The trail rope and bumping bag play an important part in all landings: they act as automatic ballast, and slow down the drag. In these days of overhead cables, neither should be lowered until it is quite certain there is no danger from this source. Once on the ground they relieve the balloon of much weight, and slow down its descent until it starts to rise. Then more weight is automatically lifted and the balloon again sinks earthwards.

The bumping bag replaces the grapnel. It is made up of wrappers and odds and ends which are put into a small net on a line of about 100ft in length.

In light winds the usual crowd of people who always seem to collect can pull the balloon to earth by the trail rope. This is known as a "trail-rope landing" and makes a second ascent possible, though perhaps with one occupant less in the basket. In good weather the balloon may be pegged down under cover for the night. Then, after the sun has expanded the gas, and so increased the lift, some of the original load of ballast can be replaced, and the "balloon goes up."

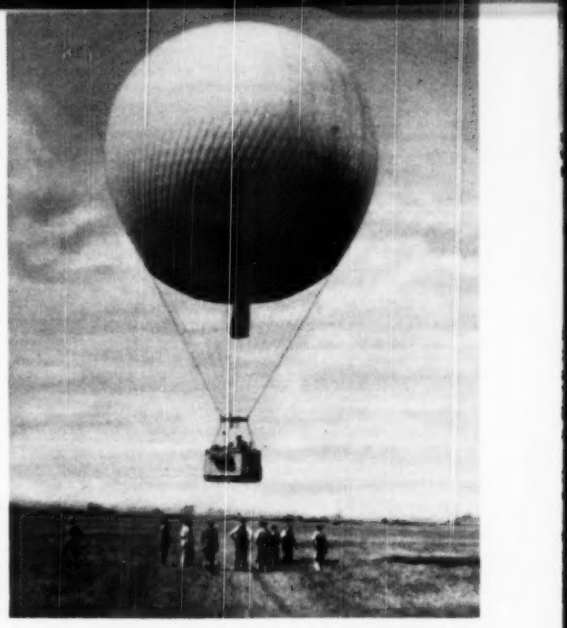
To return to windy weather: Mr. Brewer's formula was to "descend with as much weight but as little speed as possible." Hence the importance of ballasting-up at a low height. There is then no time to gain much downward momentum, and the valve can be opened fully when nearing the ground.

Instruments consist of an altimeter; statoscope or, better still, a rate-of-rise-and-fall indicator; and a thermometer. A quantity of tissue paper, as has been said, is also very useful.

The instruments should be mounted in a small wicker-work basket made fast to the car lines. A gas thermometer can be most interesting and useful, but has seldom been used in a free balloon. Airships often carry one, for the larger the ship the greater will be the effects of superheat and the like.

A recording barograph is most valuable, for it shows the pilot, by the straightness or otherwise of its line, how successful his piloting is. The barograph, and a detailed log showing details of ballasting and valving, are of much value after the flight. Binoculars and a compass must also be carried. A garden trowel is used to shovel out ballast, and a knife to cut away the trail rope in case of necessity.

As to maps, their scale depends on the proposed length of flight. The map is carried on a large board rigged outwards from the basket, so that it takes up no room. A free balloon turns slowly on its vertical axis, and this makes map-reading more difficult.



A limited amount of free ballooning took place in this country between the two wars. Here an R.A.F. balloon, piloted by W/C. R. S. Booth of airship fame, is seen leaving Cardington in 1933.

The well-known French pilot Charles Dollfus has made several ascents in this country during the past two years and in 1948 a short unofficial flying course was held at Cardington, his 10,000 cu ft balloon being used for the purpose: six ascents were made in three days.

Ideally, if facilities could be made available, all enthusiasts who wish to join the Airship Club and fly the *Bournemouth* would greatly benefit by obtaining some free-balloon experience beforehand.

Free ballooning is a very fine sport. There is no pleasanter way of taking to the air. The earth appears to drop away at the start and the balloon seems to remain motionless throughout the flight. There is no wind, and, except for the creak of the basket and ground noises, complete silence. To be alone in a small balloon in complete silence, above the clouds and out of sight of land, is a wonderful experience.

Piloting is interesting, and every flight is different. As the final landing place is unknown, every free run is a mild adventure. In windy weather the landing can be really exciting. In light winds, the final touch-down is so gentle that the pilot and passengers hardly know the exact moment that they are on the ground.

THE VANISHING AERIAL

DURING the war, radio and radar installations in aircraft steadily increased in number and complexity and, as time went on, the sprouting of more and more aerials in a variety of forms became accepted without comment. But protuberances exact a penalty in the shape of drag, and as drag varies more or less as the square of the speed, the importance of reducing the drag associated with the aerial arrays rapidly became emphasized—the more so with the advent of the turbojet, by means of which considerably higher flight speeds were made possible.

The problem facing the aircraft designers and radio engineers was how to provide aerials, either internally or as an integral part of the aircraft structure which would have the same characteristics and radiation properties as external aerials and be equally efficient. These matters had been under consideration in the Marconi research establishments for some time, when, in November, 1946, the company collaborated with de Havillands in order to evolve a system of "suppressed" aerials for the Comet.

A Lancaster fuselage was procured, and practical experiments were made with it, together with scale-model aircraft, at the Marconi laboratories and works at Writtle. From these experiments it was finally concluded that there were three practical arrangements for H.F. communication, M.F. receiver and I.L.S. aerials; two for V.H.F.; and one each for Rebecca and A.D.F. All these were carefully explored until the best in each group was found. For the final development stage, a full-sized aircraft was used, and ground tests were made at de Havillands at Hatfield.

The first Comet had no suppressed aerial during the initial flight tests, but on later flights overseas, a long-range H.F. communications suppressed aerial was fitted, together with suppressed loops for the A.D.F. The second Comet has (and, of course, all subsequent Comets will have) a totally suppressed aerial system.

The main fin, which is insulated from the stub fin, is used as an H.F. aerial. In dielectric tips fitted on the fin and tailplane are aerials for V.H.F., O.R.B. and I.L.S. In the case of M.F., a grid aerial is mounted behind dielectric flush panels in the nosewheel doors. Loop and sense aerials for A.D.F. are mounted in the top fuselage and are covered with dielectric flush panels. The I.L.S. glide-path aerial is mounted in the cockpit behind the windscreen, whilst the remaining I.L.S. aerials, D.M.E. and radio altometer aerials, are mounted behind dielectric panels in the underside of the wing-root fillet.

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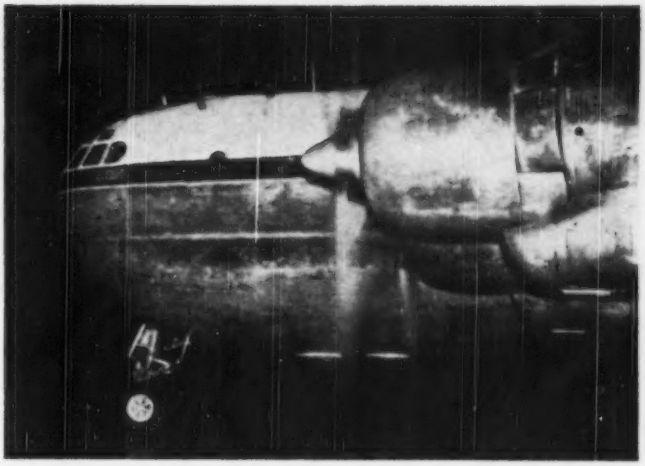
CIVIL AVIATION NEWS



NIGHT EFFECT : A striking study of a Stratocruiser departure from London Airport. The aircraft was the one in which the Prime Minister was leaving, on December 3rd, for his conference with the President of the U.S.A.

B.O.A.C. STRIKE ENDS

THE stoppage of work by B.O.A.C. electricians at London Airport ended last Saturday after the men had been out for two weeks. It is understood that the strike was called-off following talks between representatives of the airline and officials of the Electrical Trades' Union. The men returned to work on Monday beside the two non-unionists as a result of whose presence the strike was originally called. Argonaut services—22 of which were temporarily suspended—were expected to be flying within 48 hours of the resumption of work. It is estimated that the strike has cost £250,000 in lost revenue.

CHARTER COMPANIES DEBATED

ON December 6th, the House of Lords was the scene of a lively exchange of views between the Minister of Civil Aviation, Lord Pakenham, and members of the Opposition. The subject of discussion was the Government's policy towards the independent charter companies.

A former Air Minister, Viscount Swinton, complained that B.E.A. were intending to "collar" almost 80 per cent of the independent operators' business, mainly on the profitable holiday-resort routes. It appeared, he said, that B.E.A. was also intending to take over routes which it had discarded in the past but which the charter companies had successfully developed. The results of this policy would be to put the charter companies out of business entirely, but the most serious aspect of the matter was that it raised grave defence issues. In an emergency the private companies' aircraft and personnel would be needed and, indeed, it seemed folly to destroy this experienced defence reserve. Already the number of valid Commercial Pilots' Licences had fallen in the last three years from 2,493 to 1,616.

B.O.A.C.'s total revenue from charter flights in the last financial year was said to have been £767,856, which represented a loss of £71,728 and not a profit, as shown in the accounts, of almost £250,000. According to Lord Swinton, this anomaly was due to the fact that operating overheads had not been included in the account. The speaker said that the charter companies did not want subsidies, but "a fair field and no favours"; he begged those in charge of our defence programme not to let "monopolistic tendencies deprive us of a line of defence."

In reply, the Minister of Civil Aviation said that although his feelings towards the charter companies were those of goodwill, he could never forget his responsibilities as a "watchdog for the taxpayer." He was surprised by Lord Swinton's attack. The Minister thought there was a fairly widespread feeling that the major charter companies represented a valuable war potential and that "their state of health could not be regarded with indifference."

In the genuine charter field the companies were entirely free; from April, 1949, until September, 1950, the corporations had introduced to the charter companies business amounting to £233,835. Lord Pakenham said his own Ministry had, on behalf of other Government departments, placed contracts with these companies amounting to £216,000 in the past 15 months; the Air Ministry had placed contracts for some £600,000, and this business was likely to increase. In the light of those figures he considered that the Government had proved "the most substantial customer and reliable friend of the independent operators."

It had always been the intention, he said, that the Corporation should be able to undertake genuine charter work, provided they did not take unfair advantage of their subsidies to secure it. There was one field of activity, however—that of regular services offered by private companies to particular classes of the community—in which the corporations would certainly compete "without any self-denying ordinance."

In reply to an intervention by Viscount Swinton, who pressed for a definition of such services, the Minister said that a class of business had arisen which was not envisaged at the time when the Civil Aviation Act was drawn up. Lord Pakenham considered that an unfair line of criticism had been developed during the debate. His Ministry, he said, had taken a good deal of trouble over the charter companies and in some ways had modified the workings of the Civil Aviation Act in order to assist them. The corporations were not "muscling in" on them, nor could he accept the fact that they were disappearing —they had, in fact, increased in number from a pre-war level of 53 to 146 to-day. As, however, many operators were exerting themselves to see if there was any way of running regular services without infringing the Civil Aviation Act, he would give careful consideration to the legal aspects of this new type of business which had grown up since the Act was drafted.

FUEL-TAX APPEAL

ON behalf of the Royal Aero Club, the S.B.A.C., the British Air Charter Association and several other interested bodies, the Air League of the British Empire has submitted a memorandum to the Chancellor of the Exchequor, giving reasons to support their case in appealing for a grant of at least partial relief from the extra duty imposed in April on petrol.

The Air League points out that, in imposing the tax, it was originally the Chancellor's desire to restrict unnecessary consumption of petrol by private motorists and commercial road transport, and that aviation spirit only came within the ambit of the increased tax by an accident of definition.

The consumption of aviation spirit is said to be already at an irreducible minimum, as, in all flying, consumption is of necessity limited to the lowest possible amount consistent with safety.

The memorandum states that the tax as a whole cannot be applied to the aviation industry without discrimination, first against the privately owned charter companies (who have to pay the tax) in favour of the national companies who (being State-subsidized) will automatically enjoy a refund in the form of an increased grant to cover their operating deficits), and, secondly, against the aircraft and engine manufacturers. In connection with the latter, the Air League points out that in 1949 65 per cent of the aviation spirit on which duty was payable was used in the bench-testing of engines or on test flights; therefore, the extra tax which has to be paid for these purposes must represent a considerable addition to final costs, which already have to contend with severe foreign competition. Its effect on the British national airlines is held to be detrimental to the morale of personnel whose enthusiasm is directly responsible for the progress which the Corporation are now

PERSONALITIES AT PILOTS' PARTY

As in past years, the annual cocktail party of the British Air Line Pilots' Association, held at the Savoy Hotel, London, on December 5th, proved to be a cheery gathering and one that incidentally gave pilots and others the opportunity of off-the-record exchanges of views with various Higher Authorities. Among those intercepted by a "Flight" camera were (reading across, from left to right): Air Chief Marshal Sir Frederick Bowhill and Lady Pakenham; Major J. L. B. H. Cordes (secretary, G.A.P.A.N.) with D. Follows (secretary of B.A.L.P.A.); H. O'Neil, J. Matthews and Eric Rylands (chairman of Lancashire Aircraft Corporation and of B.A.C.A.); Lord Pakenham (Minister of Civil Aviation) and Capt. A. Le R. S. Upton (chairman of B.A.L.P.A.); Capt. H. Tarran Jones, Peter Masefield (chief executive, B.A.E.), Capt. F. N. Jenkinson and Lord Douglas (chairman of B.E.A.); and Capt. O. P. Jones with W. R. D. Perkins, M.P. (vice-president of B.A.L.P.A.).

CIVIL AVIATION NEWS . . .

showing. At the same time the tax is thought to be a retarding influence on the development of British internal services.

The Air League suggests that the industry might be given relief from the tax in the form of a refund; this would eliminate many administrative complications. Specific consumption figures for different types of engines are known and records are kept of engine hours. All claimants for relief, says the memorandum, "could furnish unexceptionable evidence to support their claims."

A special note is added on the subject of private owners. The Air League feels that, in view of the relief already granted to flying clubs, "most unfair discrimination is being shown."

In conclusion, the League expresses confidence that the reasons detailed in its memorandum show that the increased tax cannot be applied to aviation spirit without serious discrimination or, alternatively, that if there is no discrimination there can be no benefit to revenue. There are positively no administrative difficulties, contends the memorandum, which could prevent the granting of at least some measure of relief.

Suggestions are also given for the procedure which might be adopted for obtaining this relief. They include a requirement that the user should be responsible for the burden of proof in claiming a refund of duty paid and that claims should be made at agreed periods, either on the Excise authorities or on the appropriate ministry.

PILOT SHORTAGE: The Icelandic airline, Flugfelag Islands, seems to have overcome the problem of a scarcity of trained aircrew by importing animal labour. Actually the sheep is one of 631 recently air-lifted in Dakotas over 200 miles from the isolated Oerafi region on the south-east coast of Iceland to replace flocks depleted by foot-and-mouth disease at farms in the south-west.

NEW M.C.Z. PROCEDURES

THE introduction of the new London Control Zone, under phase II of the national airways system, will call for some alterations to the existing Metropolitan Control Zone approach procedures. These will include the experimental introduction, in the landing patterns for London and Northolt airports, of traffic-sequencing by G.C.A. search radar.

The radio range at Bovingdon, the London Airport "MVA" and Tunbridge Wells radio beacons will no longer be used; two new ranges will be introduced, at Epsom and Watford; a fan marker will be placed at Chertsey; radio beacons will be located at Brookmans Park and Crowborough; and there will be a locator beacon at Bovingdon.

Aircraft bound for London, Northolt and Bovingdon will continue, under I.F.R., to enter the zone by the present points of entry (supplemented by Brookmans Park for Northolt traffic) and will normally proceed to the Epsom range for London Airport and to the Watford range for Northolt and Bovingdon. Where inward-bound traffic is approaching under radar control, the whole of the flight-path between the range station and the point of touch-down will be considered as the "landing pattern." The intermediate approach will be flown under instructions from the G.C.A. traffic director and will consist of that part of the pattern between the range station and a point eight miles from touch-down, on the extended centre-line of the runway.

When radar control is not being used aircraft will be cleared direct from the range station to the outer marker beacon, where they will conform to a one-minute "race-track" pattern. Final approach will be carried out under the instructions of the G.C.A. talk-down controller or by I.L.S. or other systems.

The M.C.A. says that the new procedures are designed to assure a minimum of five minutes' longitudinal separation on final approach at London Airport, and a minimum of three minutes at Northolt. Vertical separation will be 1,000ft.

Captains wishing to leave the London Control Zone from London, Northolt or Bovingdon under QBI conditions will continue to use existing procedures and points of exit, although some slight alterations are being made in routeing.

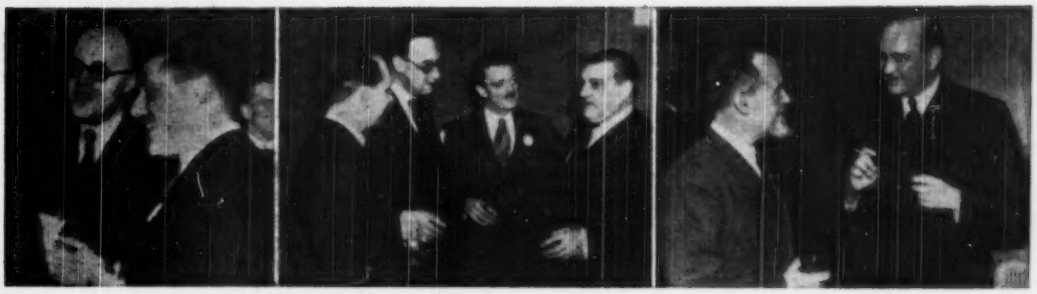
The date on which the revised procedures will take effect is shortly to be announced by the Ministry.

CZECH SERVICES CURTAILED

LAST week we reported that the U.S. authorities in Germany were considering the imposition of a complete ban on flights by Czechoslovak aircraft to Zurich and Rome, and the reduction of flights to London and other Continental points. The ban has now been put into effect and the Czechoslovak Government has been requested to explain what is termed a "disgraceful flouting of accepted international practice."

It is alleged that Czechoslovakia violated the safety regulations for flying over Germany, and that at least 30 unauthorized flights were made from November 14th-16th, carrying delegates to the Warsaw "Peace Congress." The U.S. note, delivered to the Czech Foreign Minister in Prague and to representatives in Frankfurt, intimated that it might be necessary to take even more stringent measures to assure the protection of air space over the U.S. zone in Germany.

The thrice-weekly flights to Zurich and two per week to Rome have been stopped; services to London reduced in fre-



quency from daily to six per week; and the schedules authorized to Brussels and Amsterdam reduced from three to two times weekly. In addition, any Czech aircraft passing over the U.S. zone of Germany have been ordered to cross the border at a point west of Cheb (Czechoslovakia), report periodically to U.S. control stations and adhere rigidly to a prescribed "corridor."

Like all airlines operating in this area, the Czechs fly under the provisions of a yearly permit granted by the Allied Civil Aviation Board in Germany. Replying to the U.S. note, Czechoslovakia has countered by requesting an explanation of the American action. It is claimed that the aircraft, which were said to be carrying delegates "under urgent circumstances," informed all control towers and Frankfurt airport in accordance with air-safety rules. It was the U.S. protest, say the Czechs, which first brought to the notice of the Czechoslovak Foreign Ministry the fact that permission for such flights should be sought through diplomatic channels.

BREVITIES

THE Anglo-Israeli bilateral agreement, which was initialled on September 22nd, was signed in London on December 6th by the British Foreign Secretary, Mr. Ernest Bevin, and by Dr. Eliahu Elath, Israeli Minister in Great Britain.

* * *

Philippine Airlines announce that a district traffic and sales office has been opened at 20, Pall Mall, London, S.W.1. The telephone number is Whitehall 3371.

* * *

Col. A. D. Tuttle, M.D., medical director of United Airlines, has been elected to serve on the newly organized I.A.T.A. Medical Committee.

* * *

Air Malta, Ltd., is now using Bristol Freighters on regular car-ferry services across the Mediterranean between Malta and Tunis; later it is intended to extend this route to carry tourists into Sicily.

* * *

Test flying has now begun on the first production model of the S.E.2010 Armagnac, the long-distance airliner intended for Air France's Atlantic routes. Other Atlantic news from the company includes the announcement that one Constellation service a week is being flown non-stop from New York to Paris. If, because of headwinds, an intermediate landing is necessary, passengers will be refunded $25, which is the normal supplement charge on the Company's extra-luxurious "Parisien" flights.

* * *

Following complaints of radio interference on Gemini aircraft fitted with V.H.F., the manufacturers of the Cirrus Minor engines, Blackburn and General Aircraft, Ltd., have pointed out that in two instances the trouble has been traced to faulty workmanship in modification of the screening harness in accordance with Technical Instruction J.6. Owners are advised to check that varnish has been completely cleaned from mating surfaces and that paint has been removed from the magnet faces adjacent to the metal packing. Tests have indicated that careful attention to these points should eliminate interference completely.

The following nationality markings have, since September 1st, been formally notified to I.C.A.O., in compliance with the requirements of Annex 7: Egypt, SU; Gautemala, TG; Poland, SP; and Saudi Arabia, SA.

* * *

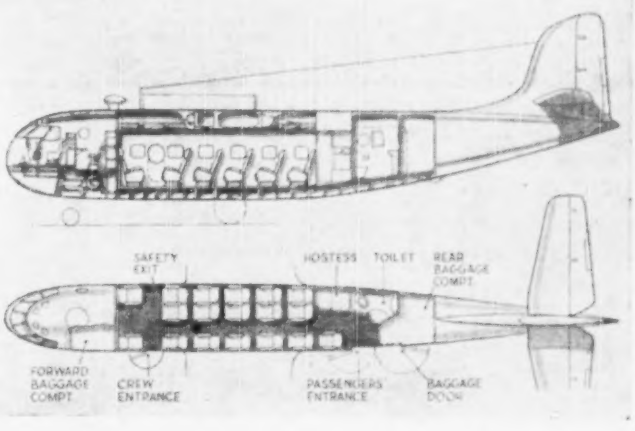
Following the withdrawal from service of all Martin 2-0-2s after one machine of this type crashed near Butte, Montana, early in November, the fleet of 21 2-0-2s operated by Northwest Airlines has restarted operations.

* * *

A Public Inquiry into the accident to B.E.A. Dakota G-AGIW, which crashed at Mill Hill on October 17th, will open on Monday, January 15th, at Church House, Westminster, London, W.1. Mr. J. Roland Adams, K.C., will conduct the inquiry; he will be assisted by G/C. J. A. Hawkings, Command Engineer Officer, H.Q. Transport Command, and Capt. C. B. Houlder, B.S.C., A.R.C.S., a B.O.A.C. senior captain.

* * *

Airlines and agents in Cairo are seeking to call the attention of the Egyptian Government to the fact that the rapidly growing flow of traffic through Farouk Airport suggests the desirability of an airways terminal in Cairo itself. The present system, by which each company has its own marshalling centre, is said to be causing considerable duplication and unnecessary expenditure, as well as entailing a considerable degree of inefficiency in the handling of passengers.



ITALIAN CONTENDER: The performance characteristics of the Breda-Pittoni 471, now undergoing trials in Italy, would appear to mark it as the aircraft most closely conforming to the specification for an ideal feederliner, as circulated recently to manufacturers by the U.S. Air Transport Association. It carries 18 passengers or 5,000 lb of freight, cruises at 255 m.p.h. and has a range (at max. a.uw.) of about 1,180 miles.

CIVIL AVIATION NEWS . . .

Argentine Airlines have announced their intention of extending their transatlantic passenger and cargo operations this month. On December 6th a service was started between Buenos Aires and Amsterdam, and flights to London will in future continue to Frankfurt. Frequencies are being increased on all routes.

* * *

American Airlines have placed an order for three more DC-6Bs; these are in addition to the 14 already on order and whose delivery is expected to begin in February. When they are in use the company's fleet will total 155 aircraft, which is thought to be the largest post-war fleet of passenger aircraft in the world.

* * *

The British Travel and Holidays Association reports that the number of foreign visitors to Great Britain during October was 5.9 per cent more than the figure for the corresponding month of last year. Of this total, the proportion which travelled by air was 38.8 per cent, while from America alone the proportion of airborne visitors was 49.9 per cent.

* * *

A new French company, Helicop-Azur, proposes to operate regular services this winter to several well-known sports resorts in the Alpes Maritimes region of France. The flights will connect at Nice-le-Var with Air France services from London and Paris. The company owns a number of Hiller 360s which, during the summer, were used on crop-dusting, forest fire-watching and general taxi duties.

* * *

With the inauguration on December 1st of a service from Berlin to Bremen, P.A.W.A. completed the final link of the new German-Austrian internal network. Bremen now has three weekly flights from Berlin, which in turn is connected by 26 flights weekly with the international terminal at Frankfurt. Services to Hamburg are flown ten times a week from Berlin, while Stuttgart, Munich and Düsseldorf are also linked by frequent regular flights.

Three Conservative Members of the House of Commons have tabled a motion calling for the provision of fog dispersal equipment at London Airport.

* * *

A British private company, Caribbean International Airways, Ltd., has begun to operate 20-seat amphibians on a weekly service between Tampa (Florida) and Belize (British Honduras) via Grand Cayman. The ten-hour flight, including a stop for lunch at Grand Cayman, is available for a single fare of only $79.

* * *

In January, a delegation from I.A.T.A. will meet representatives of the Universal Postal Union in Cairo to work out new rates for the carriage of air mail other than first-class letter mail. Their recommendations will then be presented for approval by the next U.P.U. Congress, to be held in Brussels.

* * *

At I.A.T.A.'s last annual general meeting a budget of $650,000 was approved for 1951 to cover the administrative expenses of the Association's head office. The sum will be met mainly by membership dues, based upon the proportionate amount of international payload carried by each member-airline.

* * *

The A.R.B. has made a further issue of leaflets relating to inspection procedures. They are (listed with their subjects): BL/6-7, Synthetic Resin Adhesives; PL/3-1, Propeller De-Icing—Fluid Method; EEL/3-1, Installation and Maintenance of Electrical Cables; EEL/4-1, Circuit Testing; ML/3-2, Rigid Pipes; ML/3-3, Tanks.

* * *

The operations of Italy's three State-subsidized airlines during the past year resulted in a net loss of £214,000. Alitalia, in which B.E.A. have an interest, lost £5,700, while a £200,000 deficit was recorded by Ali Flotte Riunite; the Lati company lost £8,000. Only L.A.I., which is partly owned by T.W.A., showed any profit. It has been suggested that the four companies should amalgamate in order to reduce administrative expenses, but, in view of the foreign capital invested in two of them, this course appears unlikely for the time being.

CLUB and GLIDING NEWS

TAKING full advantage of the limited amount of flyable weather during November, the Strathtay Aero Club logged a total of 208 hr. Membership continued to increase steadily, a further six members being accepted during the month. Seven Private Pilots' Licences were awarded to A.T.C. cadets in this period, bringing up to 15 the number of cadets who have qualified since the scholarship scheme began in July. A high proportion of these pupils obtained an "above average" assessment.

The onset of the long winter evenings has naturally produced an increase in social activities; to date they have included some very interesting film shows on varied travel and flying topics.

The Strathtay Aero Club is based at Perth and has a fleet of three Tiger Moths and one Auster.

* * *

HAVING completed its move from Ratcliffe, the Leicestershire Aero Club has started activities with renewed vigour from Leicester East Airfield, approximately three miles from the city itself. The control tower has been converted into a club-house, in which are to be found the ever-welcome facilities of a licensed bar. Visiting pilots, says the Club, should note that no landing charges are made in respect of private or club aircraft and that limited repair and refuelling arrangements are being made available. The airfield has three good runways and the Club hopes to obtain an operating licence in the near future. Intending members should contact the secretary, Mr. R. W. Spears, at 11, Cank Street, Leicester.

* * *

SIXTY-FIVE members of the Derby Aero Club attended the annual general meeting, held in the club-house on October 15th. Mrs. Janet Harben, who presided, reported that, in spite of the general difficulties which were being experienced by the flying-club movment, the D.A.C. had enjoyed a very successful year. Flying and social events had all been well attended and the enthusiastic support and interest shown by the public at the air display in June had been very encouraging.

In the past 12 months membership has increased from 192 to 198; five Private and ten Student Pilot's Licences have been issued and three pilots tested for, and awarded, instructors' endorsements.

The general meeting was followed a few weeks later by the annual ball, on November 24th, held once again at Burnaston House, and attended this year by over 160 members and guests. The Derby Aero Club is located at Burnaston airport and numbers among its fleet two Austers, a Magister, a Monarch and a Gemini.

* * *

ON the opposite page will be found photographic evidence of the success of the cocktail party given by Lord Kemsley at Londonderry House on December 4th to celebrate the 21st birthday of the B.G.A. The party was well attended by gliding notabilities, who included F/L. Bedford—wearing his new Gold Badge, but without the diamonds. (Attempts are being made to obtain "diamond" badges from Switzerland, as the British pattern does not permit the diamond to be mounted without damage to the enamel background.) The dance which followed in the Londonderry House ballroom, was attended by some 300 people and was acclaimed an outstanding success.

By its 21st anniversary the B.G.A. had issued 12,621 "A" Certificates, 4,257 "B," 2,300 "C," 296 Silver Badges, eight Gold Badges and three Diamond Badges (a diamond is added to the Gold Badge for each 500km distance flown, each climb of 5,000m, and every goal flight of 300km). The Association now has 13 full-member and 19 associate-member clubs, the former including the A.T.C. and the R.A.F. and R.N. Gliding and Soaring Associations; last year the clubs together flew a total of 7,134 hr.

The newly presented Kemsley Trophy, to be awarded annually to the winning club team in the National Gliding Championships was also on view during the evening. In 1947 Lord Kemsley established a fund of £100,000 to assist private flying and gliding, and it has been largely due to his generosity that sporting flying and gliding has been able to re-establish itself during the difficult post-war period.

* * *

NOW in America is F/L. "Jock" Forbes, hoping to contact the "Bishop wave" and raise the British height record once again. Standing waves, of which the Bishop wave in California is an example, are usually formed by the upward deflection of high-velocity air over a mountain ridge; the resultant wave may extend to above 40,000ft. The crest is usually followed by a down draught, then by successive upward waves and down draughts until the initial momentum of the wave is spent. The Bishop wave originates in the Owens Valley region, which is bounded on the west by the Sierra Nevada range (containing, incidentally, America's highest peak—14,495ft) and on the east by the White Mountains (about 12,000ft). The latter rise, sharply, some 8,000ft from the valley floor. Westerly or south-

TWENTY-ONE MOTORLESS YEARS : B.G.A. MEMBERS CELEBRATE

As recorded on the opposite page, the British Gliding Association celebrated its 21st birthday on December 4th. Personalities in these Flight photographs are: (top left) Lady Kemsley, Lord Kemsley and Philip Wills; (top right) Mrs. Ann Douglas and members of the Derby and Lancs Gliding Club; (right) S/L. J. Ward; Lady Kinloch, D. H. Clowes, (lower right) Dudley Hiscox, G/C. G. M. Buxton; (lower left) "Doc" Slater, D. G. Parsey and D. Snodgrass. On the left is the impressive Kemsley Trophy.

westerly upper winds give the most suitable wave formation, usually topped at great altitudes by lenticular clouds with, perhaps, strato-cumulus roll clouds at lower levels.

These tremendous forces—actually powerful enough to enable a powered aircraft to soar with engines stopped and airscrews feathered—virtually mean that the only limit to the gliding altitude record is the lack of pressurized cockpits and heated suits. The present unofficial two-seater record stands at 36,500ft, at which height the pilot had to descend to avoid frostbite. Another recent flight had to be abandoned at 32,000ft when a climb of 2,000ft/min was being experienced.

Although many powered aircraft have encountered such upward currents over Western Europe, exploration of the gliding possibilities of standing waves in England is as yet in its infancy. A wave of relatively small intensity appears occasionally near the Derby and Lancashire Club's site at Camphill; a member, Mr. H. Cook, recently made a flight of about 45 miles, reported as being in standing-wave conditions, the record of which he is entering for the Kemsley Winter Cross-country Competition. Exploration of the "Sperrins wave" in Northern Ireland formed part of an R.A.F.G.S.A. report issued earlier this year; but little has yet been published in Great Britain on these phenomena. It will be recalled that F/L. Mallet gained his Gold Badge in standing-wave conditions in France.

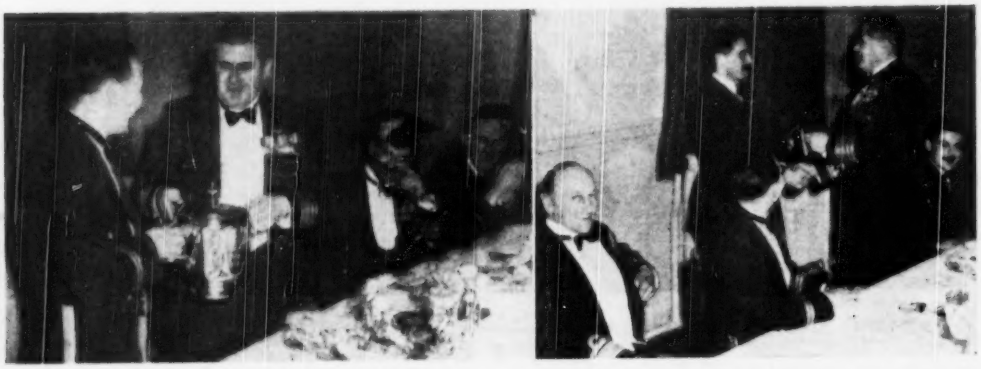
Development of wave-soaring technique in this country is generally considered desirable, but aero-tow launching will often be necessary if the wave is to be contacted. Also, the best wave conditions occur during high winds with their associated turbulence—a factor which normally discourages all but the most venturesome pilots.

* * *

APART from the first week, October was a poor month for the London Gliding Club. There were 526 launches, 189 hours flown, and one cross-country to Cambridge. One "C" certificate was gained. Flying was mostly done by regular members, but Prince Bira also visited the club and flew the Gull III. The comparative annual utilization rate for types of gliders used by the club were published in *Flight* of November 16th; the following figures for two extra types can now be added: Gull IV, 185 hr; Tutor IV, 204 hr.

E.P.T.S. FAREWELLS

Graduation of No. 9 Course at Farnborough : Top Honours for R.C.A.F.



(Left) F/L. G. A. Heck, R.C.A.F., receives the McKenna Trophy from A.V-M. J. N. Boothman, Controller of Supplies (Air). Next to them are G/C. A. E. Clouston, the Commandant (with "the Headmaster's titter"), A.V-M. T. C. Traill, Director-General of Personnel II. (Right) The runner-up, F/L. W. J. P. Straker, R.A.F., receives his prize from A.V-M. Boothman, while Rear-Admiral E. M. C. Abel-Smith, F/L. Heck (back to camera) and S/L. Martin, President, look on.

ALTHOUGH in essence a serious and even sad occasion for both the staff and students of the Empire Test Pilots' School, this year's annual dinner and presentation of the McKenna Trophy, held last Thursday at the School's Farnborough headquarters, lacked nothing of their usual happy informality.

The course is now dispersed and, in addition, several members of the staff who have completed their tours of duty have been posted. For the British contingent, however, it does not mean a complete parting of the ways, for one or two are to remain at Farnborough while the majority are posted to Boscombe Down. Members of the American and Canadian Air Forces and Navies were among those who graduated.

No. 9 course has achieved a high standard, and top honours go to Canada, F/L. G. A. Heck, R.C.A.F., having gained first place in the final passing-out results with 85 per cent. Hard behind him—within 1 per cent, in fact—was F/L. W. J. P. Straker, R.A.F., and only ½ per cent below him were F/L. J. R. Saunders, R.A.F., and Lt. F. C. Turner, U.S.N., who tied for third place with 84 per cent.

A number of senior Naval and Air Force officers were among the guests, including A.V-M. T. C. Traill, C.B., O.B.E., D.F.C., Director-General of Personnel II, but there were no formal speeches after the dinner, at which S/L. "Dickie" Martin, D.F.C. (staff instructor and surely the epitome of test-pilot keenness) presided.

The Commandant, G/C. A. E. Clouston, D.S.O., D.F.C., A.F.C., welcomed the guests and offered congratulations and good wishes to the Course. He also had a humorous word to say to departing staff members as he presented each with a gift from colleagues and students and thanked them for their excellent work. The five were Cdr. Wilson, Mr. Jones, S/L. Martin, S/L. Saxilby and F/L. Bedford. The Commandant had a special word of thanks, also, for Mr. W. G. A. Perring, Director of the Royal Aircraft Establishment, whose department had, among its many other services, made it possible to beat all previous records for flying hours on the course.

A.V-M. J. N. Boothman, C.B., D.F.C., A.F.C., Controller of Supplies (Air), presented the McKenna Trophy and a small replica to F/L. Heck, and a mug to F/L. Straker. After this, recipients of awards and several members of the staff were called to their feet, and some very competent and amusing impromptu speeches were heard.

Official recognition of the status (or lack of it) of the E.T.P.S. and its courses has been a sore point with many people for several years, but at last there seems to be some realization of its importance to the R.A.F. and, therefore, to the careers of the Service pilots concerned. An anecdote in this connection, from F/L. Bedford, was well received: it seems that his one-time C.O. warned him, seriously, when he applied to go on the E.T.P.S. course that it was "prejudicing his changes of becoming Chief of the Air Staff."

Cdr. Wilson, who has greatly influenced the School and courses during his tour of duty and will be much missed at Farnborough, said that there was a strong case to be put for supplying the School with examples of more advanced aircraft. Students needed to have experience with swept-wing types, for there was a great difference between aircraft now in service and those about to come. They would be "fancy new types" as compared with relatively obsolete straight-wing machines now in use.

A list, in alphabetical order, of those who graduated on No. 9 course is as follows:—

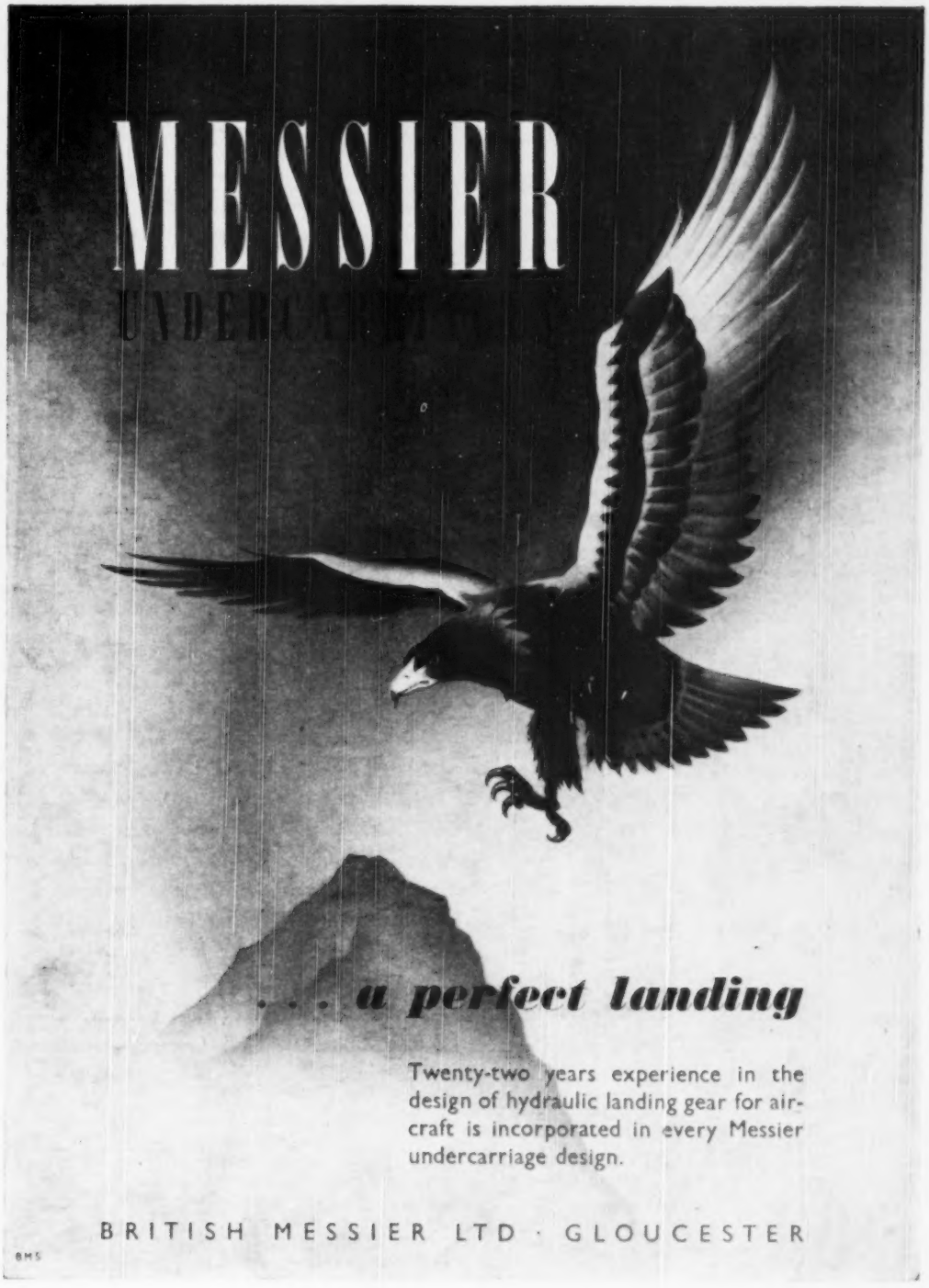
F/O. D. E. Biden, D.F.C., R.C.A.F.; F/L. J. E. Burton, R.A.F.; F/L. J. Castagnola, D.S.O., D.F.C., R.A.F.; Lt. Cdr. **R. A. Clarke**, U.S.N.; F/L. D. W. Colquhoun, R.A.F.; Major **W. W. Elliott**, U.S.A.F.; W/C. H. N. Garbett, R.A.F.; F/L. W. F. Gellatly, R.A.F.; Lt. Cdr. D. K. Hanson, R.N.; F/L. M. T. Harding, R.A.F.; **F/L. G. A. Heck, R.C.A.F.** (1); Capt. R. M. Herrington, U.S.A.F.; F/L. C. S. Hunton, D.F.C., R.A.F.; Lt. T. G. Innes, R.N.; F/L. C. H. MacFie, D.F.C., R.A.F.; F/L. D. J. Murphy, D.F.C., R.A.F.; Lt. S. B. Oliver, R.N.; F/L. W. J. Runciman, A.F.C., D.F.M., R.A.F.; **F/L. J. R. Saunders, R.A.F.** (3); Lt. J. C. Sloan, R.C.N.; **F/L. W. J. P. Straker, R.A.F.** (2); **Lt. F. C. Turner, U.S.N.** (3); F/L. L. M. Whittington, R.A.F.

SPEEDING-UP GAS-TURBINE BLADE PRODUCTION

PRODUCTION problems with axial-flow turbines were recently the theme of an important article in *Flight* (November 16th) and, in addition, they were the main topic of a recent discussion before the R.Ae.S. (pages 545-547 of this issue).

An electronic contour-follower developed by the General Electric Company for Pratt and Whitney Aircraft Division of the United Aircraft Corporation is therefore of particular interest. The device is linked to a standard jig-borer to enable—with the aid of an electronic scanner—cross-sectional drawings of the blade contour, traced on metal sheets, to be reproduced in the blank of the master blade. Accuracy at this stage is to a tolerance of one-thousandth of an inch. After a relatively simple hand-finishing operation to remove the metal between the cross-sectional cuts, the master blade is duplicated on a multi-spindle profiling machine producing four blades at a time.

The company claims that the cost of producing a master compressor-blade for a gas turbine is reduced by this process from 4,000 to 100 U.S. dollars, and the time taken may be as little as three days by comparison with the four months previously required.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NEWS from the INDUSTRY

AVRO BOARD APPOINTMENTS

TWO appointments to the board of A. V. Roe and Co., Ltd., are announced. One name is that of Mr. J. Green, O.B.E., who since 1946 has been controller-general (engineering), in which capacity he has been responsible not only for buildings, plant and equipment, but also for the production-engineering of all new projects from the prototype stage onwards. He joined the firm in 1921 and was appointed works engineer in 1929.

The second directorship is that of Mr. J. A. R. Kay, A.R.Ae.S., who has been Sir Roy Dobson's executive assistant since July, 1947. From 1941 onwards, as general superintendent, he had been responsible for the co-ordination of effort by all daughter firms and sub-contractors in the Lancaster group.

WESTLAND EXPANSION

THE recently announced acquisition of manufacturing rights for the Sikorsky S.55 helicopter was referred to at the annual general meeting of Westland Aircraft, Ltd., when the chairman, Lord Aberconway, C.B.E., LL.D., said that, in order to finance the company's activities, including this new venture, the board had decided that the time had come to increase the capital.

Application had therefore been made to the Capital Issues Committee for permission to apply part of the company's reserves in paying up one new share for each two shares held and to offer to the existing shareholders one million new Ordinary shares for subscription in cash at par. The latter application had been accepted, but the former had failed to commend itself to the Capital Issues Committee, and the new capital would be offered to shareholders after the holiday.

BLACKBURN AND G.A.L. PROGRESS

SPEAKING at the annual meeting of Blackburn and General Aircraft, Ltd., Mr. Robert Blackburn, O.B.E., A.M.I.C.E., M.I.Mech.E., F.R.Ae.S. (chairman) reported that each of the company's three anti-submarine prototypes had satisfactorily completed, or was in process of completing, its carrier trials. Flight trials were proceeding as quickly as possible with the Universal freighter, but with an aircraft of this type they would inevitably last well into next year: until they were more advanced it was too early to anticipate production orders.

There was every prospect, said Mr. Blackburn, that the company would obtain its share of rearmament contracts about to be placed, though owing to the considerable time required for tooling-up the effect of any such orders was unlikely to be felt in the balance-sheet until 1951-52 at the earliest.

Payment of a final dividend on the Ordinary shares of 6 per cent, less tax, was recommended, making a total of 10 per cent, less tax, for the year. The chairman warned his audience that a drastic reduction in profits would be inevitable next year, though he was convinced that the company's financial position was strong enough to withstand a temporary setback.

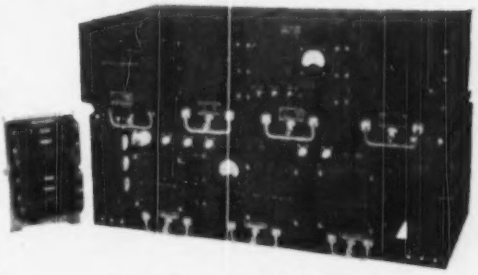
NEW PLESSEY EQUIPMENT

TWO new types of aeronautical installation are announced by the Plessey Co., Ltd., Ilford, Essex. The first is a combination of a 100-watt H.F. transmitter, Type PT.24, and a PR.23 receiver, designed to form one installation for use in large passenger-carrying, pressurized aircraft, though they may be used separately if required. On both units, 30 pre-set, crystal-controlled channels within the 2-18 Mc/s band may be selected by a switch and can be altered by insertion of the appropriate crystals.

The equipment is primarily intended to provide R/T, remotely controlled by the pilot, but may be operated from the wireless operator's position where one exists. It may also be optionally utilized for C.W. operation. Should the remote control or channel selector fail, the set may be tuned locally by disengaging the selector mechanism and manually rotating the tuning controls.

Both units will operate from either common or separate power supplies, and appropriate controllers can be supplied as required. The equipment, it is stated, complies in all respects with S.B.A.C. requirements.

The second new item, known as the PR.52 dual-diversity receiving terminal, has been designed to an International Aeradio specification. It provides for space or frequency diversity R/T reception in the 2-20 Mc/s H.F. frequency band. Primarily intended for ground-to-air communication, it is also suitable for installations where consistent reception over long-range H.F. circuits is essential. Once it is set up on the required frequency, no further adjustments are necessary.



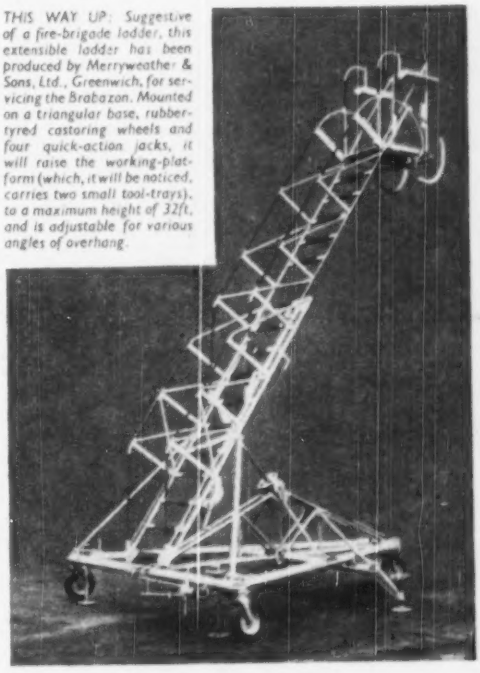
The new Plessey P.T. 23/24 H.F. equipment.

The complete equipment comprises two identical H.F. receivers, an electronic switching unit and a local loudspeaker unit. All may be mounted in a standard 19in rack.

The superheterodyne receivers, which cover the operating band in four ranges by plug-in tuning units, are designed basically for crystal-controlled operation, the crystal oscillator operating on its fundamental over the entire range. For frequency-diversity reception each receiver functions as a crystal-controlled unit on the frequency selected. When it is desired to operate a space-diversity system, both receivers are controlled by a common R/F oscillator, selection being made by a switch which also provides a change over from crystal control to manual tuning.

The audio output from each receiver is fed into the electronic switching unit via a gating circuit which is controlled by an electronic switch. This switch is in turn controlled by amplified A.G.C. voltages received from the two receivers, so that the strongest incoming R/F signal is at all times selected.

THIS WAY UP: Suggestive of a fire-brigade ladder, this extensible ladder has been produced by Merryweather & Sons, Ltd., Greenwich, for servicing the Brabazon. Mounted on a triangular base, rubber-tyred castoring wheels and four quick-action jacks, it will raise the working-platform (which, it will be noticed, carries two small tool-trays), to a maximum height of 32ft, and is adjustable for various angles of overhang.



CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Students and Test-beds

YOUR article in the November 16th issue describing the School of Gas Turbine Technology clearly shows how valuable it will be to the future of British engineering.

I notice, however, that still more students can be taught, and since much of the students' time must be spent in the lecture rooms, it would appear that the engine test-beds have a relatively low utilization.

Most London engineering colleges are without the most modern equipment in their heat-engine laboratories, primarily because of the cost. Would it not, therefore, be both desirable and economical for their final-year engineering students to be enabled to carry out gas turbine tests on the School's test-beds?

London, W.3. M. M. GATES, B.Sc.(Eng.).

Intercepting Jet Bombers

WHEN reading the November 23rd leading article in *Flight* entitled "First catch your hare," I felt that another aspect of aerial warfare seemed to call for comment. Not only must our fighter aircraft be sufficiently fast to catch their quarry, but it appears evident that our new bombers, since it has been said that they are unarmed and unarmoured, should also have adequate speed to avoid interception if they are to survive. It is presumed (perhaps wrongly) that when this type of bomber was in the design stage the "Powers that Were" assumed that the speed of a fighter would be limited to subsonic flight in a future war. If this indeed were the case, the fighter pilot who wished to attack a bomber would find himself unable to have much of a useful margin of speed to effect an interception without running "into the barrier." Now that the bomber has no such protection, since supersonic flight is possible by piloted aircraft, the same differences of speed between fighter and bomber may apply in a future war as they did in 1942.

It is, however, obvious to one and all that the performance of these bombers would be reduced alarmingly if it were found necessary to equip them with remotely operated guns and armour plate. Furthermore, if such guns were to be of use, the men who operated them have to be able to see his target, either by radar or through some *suitably defrosted* transparent plastic which would have to be pressurized to an alarming degree. (Whether it is necessary to pressurize the crew to such luxurious standards the writer considers a matter open to discussion.)

If, like wool, there is no substitute for the plastics at present in use which will enable the crew to see; if radar has not been developed to a high degree; if the bomber is not capable of speeds comparable with that of the attacking fighter (perhaps Mach 0.9): if all these factors apply to the bomber, what chance has it, unarmed, in a future war? The pilot will not even be able to see what hit him!

Now, supposing that someone has invented a suitable transparent plastic capable of withstanding the enormous pressures required, the pilot would then be able to see, and perhaps avoid an attacking fighter; and, if, by dropping his bomb load, he were able to reduce his aircraft's wing loading to less than that of the fighter or a radio controlled missile, he might still have a chance of survival by taking evasive action.

Would I be correct in my assumption that our present jet bombers fulfil very few of these seeming necessities for survival, if and when intercepted?

Holywood, Co. Down. MICHAEL CROSLEY, D.S.C.

Life-raft Refinements

WE read with interest the letter published in your issue of November 16th, regarding the photographs of an American life-raft which appeared in the London Press on November 6th.

Whilst not wishing to enter into any acrimonious discussions we think some credit should be given to the Royal Naval Life Saving Committee for the adoption of the pneumatically stressed thwart by dinghy manufacturers in this country.

This entirely new idea was designed by this company and first demonstrated by us at Felixstowe some eighteen months ago, and we would suggest that, but for the pioneer work carried out by ourselves, other manufacturers might still be using "stick-and-string" methods exactly similar to those shown on the American raft, and which we, of course, agree are now antiquated.

The 20-seat raft referred to in the letter from Elliot Equipment, Ltd.

It is of interest to record that twelve of our 20-seater rafts similar to that shown in the photograph [reproduced here—ED.] have been sent to America for testing by the United States Navy.

Cardiff. ELLIOT EQUIPMENT, LTD.,
F. E. J. Biles, General Manager.

The Hispano Gun

From Prince Stanislas Poniatowski.

WE have read with interest the first three articles in the series by Mr. A. R. Weyl, A.F.R.Ae.S., published in *Flight* under the heading "Fighter Armament."

As the English licensees for the manufacture of the Hispano gun we would like to correct the statement in the first of these articles, which appeared on page 215 of your issue of August 24th last, to the effect that "the British Hispano gun is but an adaptation of a modification" of the German Becker gun of 1916.

Although it is the fact that, as stated later in the same article (on page 219) Hispano Suiza in 1933 "acquired a licence for the Becker 'Oerlikon' gun with its improved ammunition and modified it for a combination with a 12-cylinder engine to fire through the hollow airscrew shaft," extensive testing which followed revealed several major difficulties in the Becker principle of a "free blowback" when incorporated in a weapon combined with a 12-cylinder engine.

This led Mr. Marc Birkigt of the Hispano Suiza Company (mentioned on page 218 of the same issue) to design a new gun with a mechanical locking of the breach during the firing of the round, unlocking of the breech being obtained by direct action of the gas.

Every British Hispano gun has been built to this design of Mr. Marc Birkigt's and is therefore in no way "an adaptation of a modification" of the German Becker gun of 1916.

We hope that the above-mentioned passage concerning the Hispano gun is the only inaccuracy in an otherwise attractive series of articles and that you will see fit to publish this letter so as to correct that statement.

BRITISH MANUFACTURE & RESEARCH CO., LTD.,
Ponintowski,
Grantham, Lincs. Chairman.

PHOTOGRAPHY REVIEWED

FOR those interested in photography—amateur or professional—there will be few Christmas presents more welcome than a copy of *Photograms of the Year*, 1951.* This handsomely produced 56th edition contains 82 outstanding studies, selected from several thousand entries, by photographers of twenty different nations. In the 20-page introduction are reviews of photography in Britain and abroad, and an appreciation of the contents.

* *Published by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 7s 6d in paper cover (postage 6d) or 10s 6d cloth-bound (postage 7d); or from booksellers and photographic dealers.*

"FLIGHT" NEXT WEEK: **Notable British aircraft of the past year will be the subject of a special illustrated review in the Christmas number of *Flight* (December 21st): this will be an enlarged issue, with seasonable features in addition to usual contents.**

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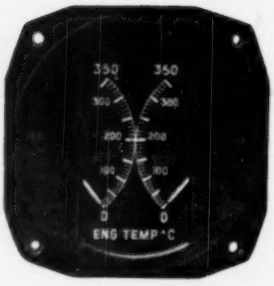

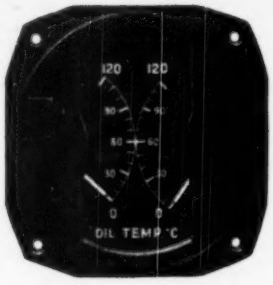

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Above : Model 5128. Dual Engine Temperature Indicator, comprising two Millivoltmeters of 100° scale housed in large-size S.A.E. case. For use in conjunction with copper/constantan, iron/constantan or chromel/alumel thermocouples.
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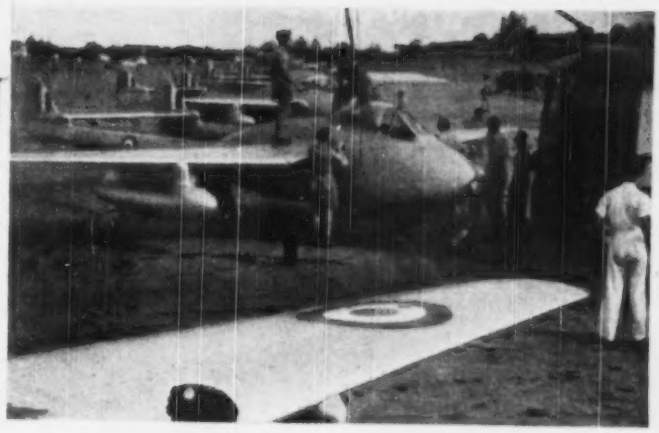


Seletar groundcrews set about refuelling and servicing the Vampires immediately after their arrival, reported below. These first six aircraft have been allotted to No. 60 Squadron for the defence of Singapore.

F.E.A.F. VAMPIRES DELIVERED

PHOTOGRAPHS on this page record the arrival at Singapore of the first six Vampires flown from England for fighter squadrons of the Far East Air Force. They were taken by the Art Editor of *Flight*, John Yoxall, who is now concluding a tour of R.A.F. bases in the Far East. The Vampires arrived over Seletar, he reports, one minute behind their scheduled E.T.A. of 1500hr on December 2nd. They were flown by six pilots of Transport Command Ferry Flight, led by S/L. P. J. S. Shaughnessy, D.F.C., A.F.C., and accompanied by a navigating Mosquito (F/S. Plt. Stokes and F/S. Nav. Simpson). After servicing at Seletar, the Vampires were due to be delivered to No. 60 Squadron for employment in the defence of Singapore.

The journey from Britain to Singapore —nearly 9,000 miles—was made by way of Malta, North Africa, Egypt, Jordan, Iraq, India, Burma and Siam, and represents the longest jet-fighter delivery flight made by any air force. Normal cruising speed was 350 m.p.h. The Vampires are F.B. Mk. 5s, of the type now in service with R.A.F. squadrons at home, in Germany and in the Middle East.

No untoward incidents or mechanical troubles were experienced *en route*—a tribute to the high serviceability of the Vampire under varying conditions of weather and airfields. On arrival at Singapore even the silver finish of the aircraft showed no signs of travel, apart from slight peeling of dope from the noses of one or two drop-tanks. Two Dakotas of No. 38 Squadron, attached to F.E.A.F., followed the Vampires' route, carrying spares and servicing parties. From this successful beginning, further delivery flights will continue until re-equipment is complete.

After flying the final leg of their journey, from Butterworth, the Vampires flew over Seletar in formation before landing. On arrival, the pilots were welcomed by Air Marshal Sir Francis Fogarty, C.B., D.F.C., A.F.C., C.-in-C., Far East Air Force, and G/C. J. T. Mynors, acting commander of the Seletar maintenance base.

(Right) Pilots responsible for delivering the six Vampire 5s are seen with the C.-in-C. and Base Commander, Seletar: (left to right) F/S. Plt. W. J. Ryall; F/S. Plt. D. Smith; F/L. R. Puda; S/L. P. J. S. Shaughnessy; Air Marshal Sir Francis Fogarty, C.-in-C., F.E.A.F.; F/S. Plt. H. Edwards (presumably in borrowed hat); G/C. J. T. Mynors; and F/S. Plt. Williams.

(Below) One of the Vampires lands at Seletar.

"Flight" photographs

SERVICE AVIATION . . .

R.A.F. Appointments

AIR VICE-MARSHAL J. D. BREAKEY, C.B., D.F.C., has been appointed A.O.C., No. 21 Group, Flying Training Command. His place as A.O.A., Bomber Command, will be taken by A.V-M. Sir Francis Mellersh, K.B.E., A.F.C., who has been A.O.C., Malaya, since May, 1949. Both appointments take effect from March, 1951.

A. Cdre. E. C. Ferman, C.B.E., will assume the acting rank of Air Vice-Marshal when he becomes S.A.S.O., Maintenance Command, on February 5th, 1951. A. Cdre. Ferman is at present Director of Equipment (D) at the Air Ministry. In January next, A. Cdre. J. R. Whitley, C.B., C.B.E., D.S.C., A.F.C., who has been attending the 1950 Course at the Imperial Defence College, becomes A.O.A., B.A.F.O., with the acting rank of Air Vice-Marshal.

Two other appointments taking effect in January are those of A. Cdre. B. D. Nicholas, as A.O.C., No. 27 Group, Technical Training Command, and A. Cdre. J. Marson, as A.O.C., No. 42 Group, Maintenance Command. A. Cdre. Nicholas is at present Director of Signals (Organization) at the Air Ministry, and A. Cdre. Marson was until recently Senior Technical Staff Officer, Coastal Command.

A. Cdre. J. M. Colin, C.B.E., who has been attending the 1950 Course at the Imperial Defence College, has been posted to the Air Ministry for duty, beginning in January, with the Defence Research Policy Committee. Another student at the Defence College, G/C. G. N. E. Tindall-Carill-Worsley, C.B.E., has been appointed to Flying Training Command as Senior Technical Staff Officer with the acting rank of Air Commodore.

615 Squadron Party

A GOOD deal of help and kindness is directed towards No. 615 (County of Surrey) Squadron, Royal Auxiliary Air Force, by friends, local business men and officials in the Croydon area. Last Saturday, December 9th, this neighbourliness was repaid, to some extent, by an excellent Christmas cocktail party which the squadron gave for its local friends at its Tavistock Road town headquarters. The Commanding Officer, S/L. Neville Duke, and Mrs. Duke were the principal hosts, Dr. Frank Manning the energetic P.M.C.

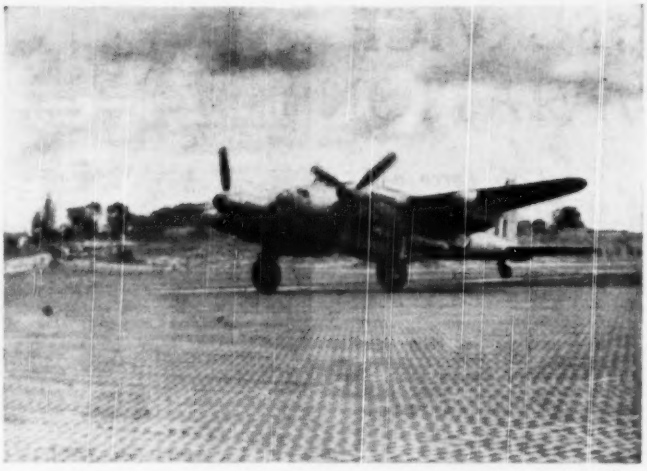
Lord Portal at Cranwell

MARSHAL of the R.A.F. Viscount Portal of Hungerford was due to take the combined graduation parade, at Cranwell yesterday, of the 51st (General Duties) and 2nd (Equipment and Secretarial) entries.

Glider-pilot Memorial

FIELD MARSHAL LORD ALANBROOKE unveiled a memorial window in Salisbury Cathedral on December 9th to 551 fallen officers and men of the Glider Pilot Regiment. The window also commemorates 67 members of the R.A.F. killed while seconded to the Regiment. The window was dedicated by the Bishop of Salisbury.

Before the service, Lord Alanbrooke, who is Colonel Commandant of the Regiment, inspected guards of honour from the G.P.R. and the 63rd Rifle Squadron, R.A.F. Regiment. Among those present at the unveiling were Air Marshal Sir Leslie Hollinghurst, A.V-M. L. Darvall and Sir Frederick Handley Page.



"Flight" photograph.

PATHFINDER: This Mosquito P.R. 34, flown by F.S. Plt. Stokes and F.S. Nav. Simpson, escorted six Vampire 5s on a 9,000-mile delivery flight from Britain to the Far East. The jet fighters' arrival at Singapore is illustrated on the preceding page.

R.A.F.'s Thanksgiving

WITH a total of £5,714 to date, the R.A.F. heads the list of Service contributions to the Lord Mayor's National Thanksgiving Fund. Army contributions total £4,190 and the Royal Navy and Marines have given £289.

New Auxiliary C.O.

WING COMMANDER J. A. G. COATES, D.F.C., has been appointed Commanding Officer of No. 2608 (North Riding) Light A.A. Squadron, R.Aux.A.F., which is located at Thornaby, Yorks. During the war—from July, 1940, to June, 1941—W/C. Coates flew with No. 2608 Squadron's affiliated fighter squadron, No. 608.

R.A.F.R.O.

THE King has been pleased to approve that the Reserve of Air Force Officers shall in future be known as the Royal Air Force Reserve of Officers. The new title provides recognition of the long and valuable service rendered by this force, which was formed in 1921 and consists of officers who have served in the regular Air Force on short-service engagements.

Week-end Naval Exercise

SEAFIRES of three R.N.V.R. fighter squadrons were based on Lee-on-Solent last Sunday for Exercise *Volunteer 1*, a co-operative manœuvre between the Territorials and Naval reserves. Bad weather hampered the exercise, which was held north of Chichester and entailed location of Territorial and Marine ground forces by the Reserve squadrons—Nos. 1831 (from Stretton), 1832 (from Culham) and 1833 (from Bramcote). The ground forces were defended by a fourth, Regular, squadron—No. 802 (Sea Furies), from R.N.A.S. Ford.

Posts for Retired Officers

THE decision to replace R.A.F. adjutants at A.T.C.-wing headquarters from civilian life is expected to release about 50 regular officers for general duties. Most of the candidates selected to replace them will be officers who have recently retired from the R.A.F.; they will be appointed to R.A.F.O. commissions as flight lieutenants and will wear R.A.F. uniform.

A.D.C.s Appointed

APPOINTMENTS are announced of two new Aides-de-Camp to the King: G/C. T. U. C. Shirley, C.B.E., in succession to G/C. C. E. Maitland, D.F.C., A.F.C., who has retired from the Service; and G/C. F. J. A. Tanner. G/C. Shirley belongs to the Technical Branch and was recently appointed Director of Servicing and Repair at the Air Ministry, with the acting rank of Air Commodore. G/C. Tanner is Commandant of the R.A.F. Regiment Depot at Catterick.

New Attacker Trials

TWO production-model Vickers-Supermarine Attackers recently completed some 200 deck-landings during an intensive series of trials in H.M.S. *Illustrious*. During the trials they operated with extra fuel in their 250-gallon belly-tanks. Capt. H. P. Sears, commanding officer of R.N.A.S. Ford, and pilots of the Service Trials Unit (Lt. Cdr. Bartlett, Lt. Tuttle (U.S.N.), Lt. Cawood and Lt. Bellamy) piloted the Attackers. Lt. Blackmore was in charge of the deck crew and maintenance party, which kept up a high rate of serviceability with both machines throughout the trials.

First deck-landings with the Attacker, which will shortly be in Naval squadron service, were made in the *Illustrious* over three years ago. The Supermarine 510, swept-wing version of the Attacker, recently completed its first deck-landing tests.

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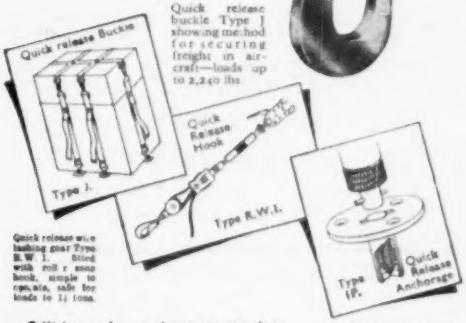

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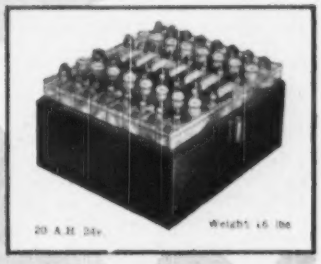

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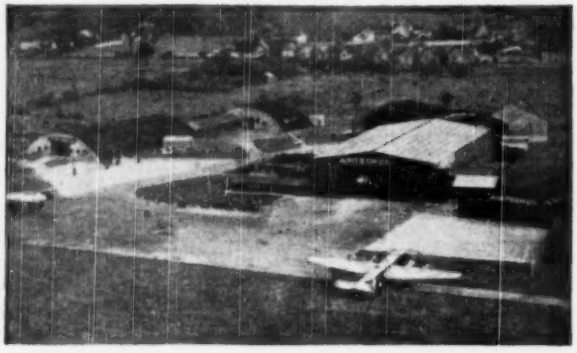

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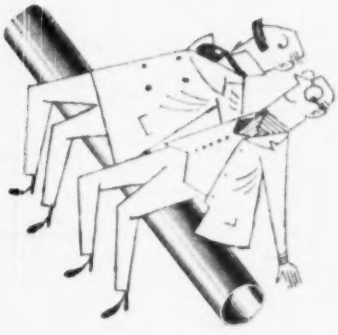

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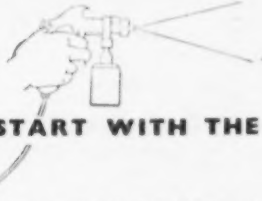

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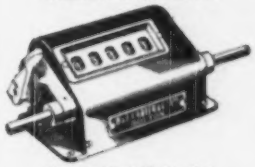

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PUBLIC ANNOUNCEMENTS

NOTICE is hereby given that Electro-Hydraulics, Ltd., seek leave to amend the complete specification of the letters patent No. 622665 for an invention entitled "Improvements in or relating to shock absorbers."

PARTICULARS of the proposed amendments were set forth in the Official Journal (Patents), No. 5225, dated December 6th, 1950.

ANY person may give Notice of Opposition to the amendment by leaving patents form No. 56 at the Patent Office, 25, Southampton Buildings, London, W.C.2, on or before January 6th, 1951.

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CHARLES BARRATT, Town Clerk.

COUNCIL House, Coventry. November, 1950. [5629

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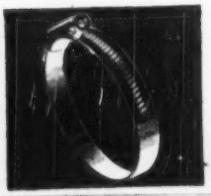

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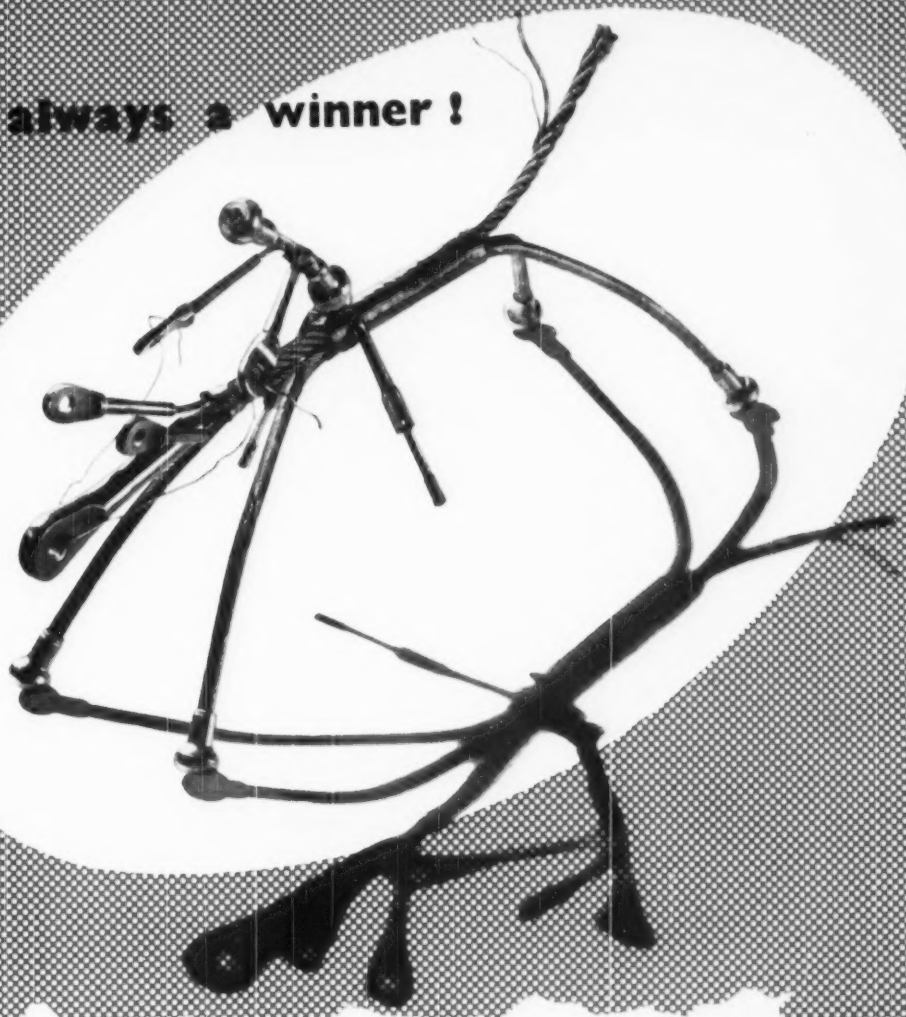

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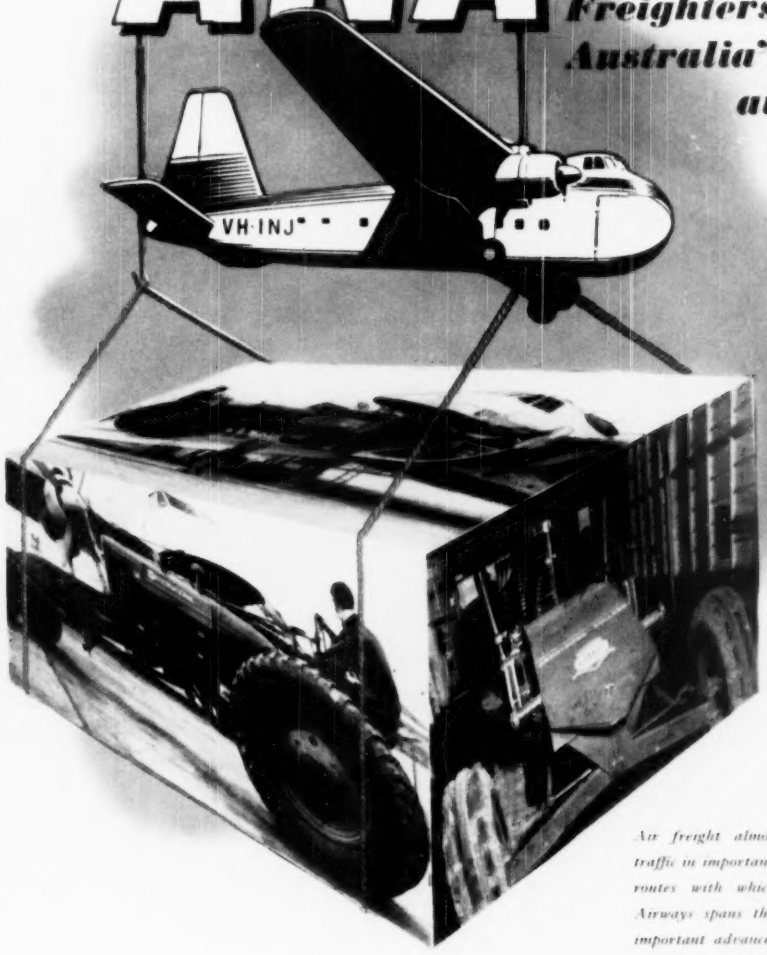

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